Variation in Spelling Ability in Children:

Precursors, Acquisition, and Instruction

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ISBN/EAN
978-94-6259-253-7

Design and lay-out
Promotie In Zicht, Arnhem, the Netherlands

Print
Ipskamp Drukkers, Enschede, the Netherlands

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Proefschrift

ter verkrijging van de graad van doctor
aan de Radboud Universiteit Nijmegen
op gezag van de rector magnificus prof. mr. S. C. J. J. Kortmann,
volgens besluit van het college van decanen
in het openbaar te verdedigen op vrijdag 19 september 2014
om 12.30 uur precies

door

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geboren op 15 april 1985
te Wageningen

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Doctoral Thesis

to obtain the degree of doctor
from Radboud University Nijmegen
on the authority of the Rector Magnificus prof. dr. S. C. J. J. Kortmann,
according to the decision of the Council of Deans
to be defended in public on Friday, September 19, 2014
at 12.30 hours

by

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Chapter 1

General Introduction

General Introduction

When you start reading this thesis, you most probably have ample experience with both reading and spelling. Please get a pen and write down the name of the Italian coffee drink, traditionally prepared with espresso, hot milk, and steamed-milk foam. This coffee drink is called _____. A simple search on Google[1] gives 225.000 hits for 'cappuchino', 911.000 hits for 'capuchino', 2.020.000 hits for 'capuccino', 3.680.000 hits for 'cappucino', and 32.700.000 hits for 'cappuccino'. If you wrote 'cappuccino', you spelled it correctly. The large number of alternative spellings indicates the complexity of spelling as a skill. Even rather skilled spellers sometimes have doubts about the correct spelling of a word and have to look that word up in a dictionary or use the spelling checker. With respect to reading, however, skilled readers rarely have doubts about how to read a word aloud.

The asymmetry between spelling and reading is also visible in academic research. A search on Google Scholar[2] resulted in almost four million hits by entering the search term 'reading', whereas the search term 'spelling' did not even provide a million hits. The attention for spelling in scientific research is clearly lagging behind that of reading.

This asymmetry also reveals itself in educational practice, as it is harder for children to learn to spell than to learn to read, resulting in large individual differences among spellers. Because knowledge is lacking concerning the question whether children who differ in their spelling level require different instructional approaches, the present research focuses on individual variation in spelling and its relation to effective instruction. Individual variation was examined with respect to precursors of spelling, spelling acquisition, and spelling instruction. With respect to spelling acquisition, both quantitative and qualitative differences in spelling acquisition were examined. With respect to spelling instruction, the role of spelling instruction and the effects of individual variation on spelling instruction were examined.

Spelling Acquisition

When children are four, five, or six years old, most of them make their entrance to the world of written language. In the years before, they have already been exposed to written language by, for example, books that have been read to them and letter symbols and words that they have seen in their daily life. Usually when children

1 Results of an advanced search on the 26th of November 2013 with the language set on English and the region set on United States. The search term was entered in quotes in the field 'this exact word or phrase'.

2 The results of a search on the 26th of November 2013 gave 3.880.000 hits for 'reading' and 864.000 hits for 'spelling'.

enter primary school, they will start to write letter symbols, words, sentences, and stories. The child will discover that each word is a composition of various sounds or phonemes, and that each phoneme can be connected to a corresponding letter symbol or grapheme. In the early stage of learning to spell, the child acquires the ability to segment a word into its phonemes. For example, a child becomes able to segment the word /stɑr/ into the phonemes /s/, /t/, /ɑ/, and /r/. Moreover, the child has to acquire sound-letter knowledge to connect each phoneme to its corresponding grapheme. The phoneme /s/ has to be connected to the grapheme S, the /t/ to the grapheme T, and so on. When a child is able to segment a word into phonemes and connect each phoneme to its corresponding grapheme, the child will be able to write the word STAR. Note that, the word STAR is consistent in its phoneme-to-grapheme relationships.

However, children will also be confronted with words that are inconsistent in their phoneme-to-grapheme relationships, examples are DREAM and HOPE. After a while, children learn that a large number of phonemes can be represented by two or more different graphemes. For example, the EA in DREAM could also be spelled EE, IE, and even EY. These inconsistent words can only be spelled correctly when phonological, morphological, and/or orthographic rules are used, when words are spelled by analogy to other words, or when words are known by heart.

Examples of commonly used spelling rules are phonological, morphological, and orthographic rules. To apply a phonological spelling rule, a speller needs to know how phonemes map onto graphemes (Steffler, 2001). For example, in English, the phoneme /k/ can be represented by K, C, CK, or CH. The correct grapheme depends on where it occurs in the word. To apply a morphological spelling rule, the speller has to have knowledge of the meaning of words and their derivatives (Steffler, 2001). An example in the English language is knowing that the word SIGNATURE is derived from SIGN and has to be written in the same way, although it is pronounced differently. Phonological and morphological rules are based on the phonology of the language, and may be relatively easy to learn. To apply an orthographic spelling rule, the speller has to have knowledge of how graphemes go together according to the typical structure of a particular language (Steffler, 2001). An orthographic rule is not sensitive to the phonological context, but to the orthographic context (Nunn, 1998). An example in the English language is that an E at the end of a one-syllable word makes the preceding vowel long. For instance, the E in HOPE makes the O long.

To summarize, after a child has acquired the ability to segment words into phonemes and to connect each phoneme to its corresponding grapheme, it is able to write words that are consistent in their phoneme-to-grapheme relationships. To be able to also spell phoneme-to-grapheme inconsistent words, phonological, morphological, and/or orthographic rules have to be applied.

There are roughly two ways to learn the spelling of words that are not phoneme-to-grapheme consistent, that is, by memorization or by the application of spelling rules. In the case of memorization, spellers memorize each word separately. Pure memorization may be effective for words for which there are no spelling rules that they obey to or there are no other words that are spelled analogous to these words. There are various ways to memorize new words. It appears to be most effective to study the word first and thereafter write the whole word from memory (Bosman & de Groot, 1992; van Leerdam, Bosman, & Van Orden, 1998). Although memorization is required and certainly feasible for learning the spelling of a particular category of words, the main disadvantage is that it is impossible to know the spelling of all words by heart. Moreover, it may cause the wrong belief that there are no underlying regularities for the spelling of words (Berninger et al., 1998; Henry, 1989).

In contrast to memorization, to learn to apply spelling rules enable spellers to not just write practiced words correctly, but also use this knowledge for the application of new words within that category. For example, when a speller has acquired the orthographic rule that the E in HOPE makes the O long, he or she can transfer this knowledge for spelling the word HOME. A spelling rule explicates the underlying regularities of the orthography. Spellers can also use a structured approach to spell inconsistent words of multiple word categories correctly. A structured approach can involve the use of syllable or phoneme segmentation in combination with the application of spelling rules. Segmenting each word into syllables and subsequently use one or more spelling rule(s) enable children to spell all different kinds of words correctly.

Precursors

There are a number of kindergarten skills that predict the spelling acquisition of young children. The precursor skills with the highest predictive value are phonological awareness (Bradley & Bryant, 1983; Caravolas, Hulme, & Snowling, 2001; Furnes & Samuelsson, 2010; Lervåg & Hulme, 2010; Muter, Hulme, Snowling, & Taylor, 1998; Ouellette & Sénéchal, 2008; Stage & Wagner, 1992), letter knowledge (Caravolas et al., 2001; Furnes & Samuelsson, 2010; Lervåg & Hulme, 2010; Muter et al., 1998; Ouellette & Sénéchal, 2008), working memory (Lervåg & Hulme, 2010; Stage & Wagner, 1992), and rapid naming (Furnes & Samuelsson, 2010; Lervåg & Hulme, 2010). Phonological awareness can be defined as the ability to segment words into their phonemes (i.e., phoneme segmentation, Bosman, 2004). Phoneme segmentation is a prerequisite for spelling, because spelling requires children to divide a word into its phonemes and connect each phoneme to its corresponding grapheme(s). Consequently, letter knowledge is a second major precursor, because spelling in an alphabetic language requires the knowledge of all graphemes that

represent the phonemes of the language. A third major precursor is working memory, because children have to keep track of the coupling of phonemes to graphemes in the right order, to be able to spell words correctly. Spelling tasks put a relatively heavy demand on working memory processes (Lervåg & Hulme, 2010). Moreover, to spell words, lexical phonological information has to be retrieved from long-term memory. Therefore, the fourth precursor of spelling is rapid naming, since rapid naming involves the retrieval of lexical phonological representations from memory (Ramus & Szenkovits, 2008).

Spelling skill

Spelling acquisition is characterized by large inter-individual variation. It is not yet clear why some children learn to spell fluently, whereas others develop spelling problems. It is also unknown whether spelling acquisition of poor spellers is similar to that of good spellers. Of course there are quantitative differences between poor and good spellers. After all, poor spellers make more spelling errors than good spellers. But whether these differences are also qualitative in nature is still unsolved. A frequently used way to compare the quality of the spelling processes of poor and good spellers is a comparison of spelling errors. The type of errors spellers make reveals a speller's knowledge of underlying orthographic principles or rules. For example, a speller who has spelled RABIT instead of RABBIT may have used the correct phonological strategy, but did not apply the orthographic rule properly.

There is abundant evidence that poor spellers make more errors than good spellers, but the kind of errors is quite similar in both groups (e.g., Bailet, 1990; Bosman & Van Orden, 1997; Bruck, 1988; Holligan & Johnston, 1991; Holmes & Peper, 1977; Kamhi & Hinton, 2000; Moats, 1983; Newman, Fields, & Wright, 1993; Waters, Bruck, & Malus-Abramowitz, 1988). Both poor and good spellers appear to make more errors on irregular than on regular words (Bruck, 1988; Rohl & Tunmer, 1988), and more on CCV than on CVC words (i.e., C stands for consonant and V for vowel; Bruck & Treiman, 1990).

Both poor and good spellers mainly commit phonetically acceptable errors (e.g., Bosman & Van Orden, 1997; Bruck & Waters, 1988; Frith, 1980; Moats, 1983; Nelson, 1980; Pennington et al., 1986). A phonetically acceptable spelling error can be pronounced identically to the target word when grapheme-to-phoneme correspondence rules are followed (e.g., Bruck, 1988; Holmes & Ng, 1993). For example, CHEEP is a phonetically acceptable spelling error for the target word CHEAP, whereas CHEAM is not.

The conclusions researchers draw about the extent to which spelling errors of poor spellers are similar to those of good spellers depend on how the control groups are matched (i.e., by chronological age vs. by spelling level; Lennox & Siegel,

1996), tests and tasks that are used (Kamhi & Hinton, 2000), but also and even more importantly, the language in which the data are collected (Ziegler & Goswami, 2005), and the way in which the errors are analyzed (Bruck, Treiman, Caravolas, Genesee, & Cassar, 1998; Bruck & Waters, 1988; Caravolas et al., 2001; Cassar, Treiman, Moats, Pollo, & Kessler, 2005; Kamhi & Hinton, 2000; Lennox & Siegel, 1996; Silliman, Bahr, & Peters, 2006). A nice example of this final aspect was shown by Charles Read's son who wrote the letter string CINPYEUTER (Read, 1981, p. 118). At first sight, this looks like a non-phonological error. However, when you know that this 6-year old boy intended to write the word COMPUTER, it becomes clear that CINPYEUTER actually is a phonologically acceptable error. Evaluating spelling errors solely based on grapheme-to-phoneme rules underestimates the phonetic complexity of the spellings of children (Moats, 1993; Read, 1971; Treiman, 1993).

Although spelling errors of younger or poor spellers are usually less consistent than those of older or average or good spellers (Bosman, 1994; Bosman & de Groot, 1991; Bruck, 1988; Bruck & Waters, 1988; Lennox & Siegel, 1993; Waters, Bruck, & Seidenberg, 1985), there is no evidence that phonology plays a less important role in these younger or poor spellers (e.g., Bosman & de Groot, 1991; Bruck, 1988; Holligan & Johnston, 1991; Van Orden, Pennington, & Stone, 1990). Thus, the majority of studies seems to indicate that the differences between poor and good spellers are predominantly quantitative rather than qualitative in nature.

After being aware of the existence of the regularities and rules in the acquisition of spelling, another important aspect of becoming a skilled speller is the development of 'spelling consciousness'. To be able to know to which words, or word parts, particular spelling rules or approaches have to be applied, or to know which words have to be known by heart, spellers have to actively think about their own spelling. Thinking and reflecting on one's spelling process and the ability to detect and correct one's spelling errors is called spelling consciousness (Block & Peskowitz, 1990; Bosman, 2004; Lull, 1917). Researchers agree that average or good spellers usually have a better developed spelling consciousness than poor spellers (e.g., Deshler, Ferrell, & Kass, 1978; Jansen-Donderwinkel, Bosman, & van Hell, 2002; Willemen, Bosman, & van Hell, 2002). Poor spellers (i.e., students with learning disabilities) make more spelling errors in free writing assignments than good spellers, which indicates that they have difficulties assessing which words they are able to spell correctly (Jansen-Donderwinkel et al., 2002; Willemen et al., 2002). Moreover, poor spellers have more problems detecting spelling errors (Deshler et al., 1978). Spellers who are able to accurately evaluate the correctness of their spelling have a higher spelling-performance level (Block & Peskowitz, 1990; Hendrickson & Pechstein, 1926), and are better at choosing the most appropriate spelling strategies for writing particular words (Kreiner & Green, 2000).

To sum up, although the spelling acquisition of poor and good spellers is qualitatively similar, poor spellers have a lower spelling-consciousness level than good spellers and have difficulties assessing their own spelling errors. Both aspects may have implications for effective spelling instruction.

Spelling Instruction

Spelling depends, even more so than reading, on instruction. Many previous studies have established that, although spellers are able to acquire some spelling knowledge by themselves, to achieve a proper spelling level, spellers need formal spelling instruction (e.g., Allal, 1997; Bosman, 2004; Bosman & de Groot, 1992; Brown, Sinatra, & Wagstaff, 1996; Butyniec-Thomas & Woloshyn, 1997; Devonshire & Fluck, 2010; Faber, 2006; Fulk & Stormont-Spurgin, 1995; Gettinger, 1993; Gettinger, Bryant, & Fayne, 1982; Graham, 1999, 2000; Wanzek et al., 2006). Fulk and Stormont-Spurgin (1995) reviewed 35 spelling-intervention studies and showed that all 35 studies lead to an increase in spelling performance.

Spelling instruction may focus on, among others, teaching a way to memorize words, a spelling rule, or teaching a structured approach that can be used to spell inconsistent words of multiple word categories correctly. There are several strategies that can be taught to spellers for memorizing the spelling of words. Children with learning disabilities, who are often poor spellers (Carpenter & Miller, 1982; Deshler et al., 1978; Deshler, Schumaker, Alley, Warner, & Clark, 1982; Kirk & Elkins, 1975; Poplin, Gray, Larsen, Banikowski, & Mehring, 1980), often fail to develop efficient study strategies for the memorization of words by themselves (Graham & Freeman, 1985). There is evidence that spellers do not learn specific words until these are taught (Curtis & Dolch, 1939; McIntyre, 1995). This is especially true for poor spellers (Curtis & Dolch, 1939; McIntyre, 1995). However, both poor and good spellers will not easily achieve high levels of spelling by just reading (Bosman & de Groot, 1992; Bosman & van Leerdam, 1993; Graham, 1999, 2000; van Leerdam et al., 1998), because it is hard for them to detect orthographic principles by themselves and use them to spell new words correctly (Assink, 1986 (in Dutch); Nunes, Bryant, & Bindman, 1997 (in English); Totereau, Thevenin, & Fayol, 1997 (in French); van Doorn-van Eijsden, 1984 (in Dutch)). This means that spelling instruction is necessary for both poor and good spellers (Gettinger, 1993).

An example of an effective procedure for the memorization of ambiguous inconsistent words that can be taught to spellers is the copy-cover-compare procedure (Hubbert, Weber, & McLaughlin, 2000; Murphy, Hern, Williams, & McLaughlin, 1990). This strategy is useful for words with an ambiguous part. An example of a word for which memorization may be used, is the word CHEAP, because alternative spellings for the EA are EE, IE or EY. For some of these words there are underlying rules that state how to spell the ambiguous part. But sheer

memorization may be more helpful when underlying rules are complicated or when there are only few words that can be spelled with these complicated rules. Ramsden's work (2008) gives an overview of the underlying structure and the spelling rules of the English language.

This copy-cover-compare procedure requires spellers to study the spelling of a word closely, copy the word, cover the word, write the word from memory, and finally check the word and correct it when needed. This procedure is quite similar to the visual-dictation approach that has been used in Dutch studies (van Hell, Bosman, & Bartelings, 2003; van Leerdam et al., 1998). Visual dictation requires spellers to study a word carefully for a few seconds, and subsequently the spellers have to spell the word from memory while the word is covered. After that, the word is made visible again and the speller has to check the spelling and makes corrections when needed. The visual dictation approach is effective for both poor and good spellers (van Hell et al., 2003; van Leerdam et al., 1998). An important aspect of the copy-cover-compare and visual-dictation method is spelling from memory instead of just copying the word. Spelling from memory is particularly effective for poor spellers (Bosman & de Groot, 1992; van Leerdam et al., 1998). This may be because good spellers may neglect the fact that the word remains visible and just write it from memory by themselves, whereas poor spellers may just copy the word while they keep looking at the target word, and consequently do not spell the word from memory.

Another effective procedure for the memorization of words that are spelled inconsistently is regularizing the spelling of these words (also known as over-pronunciation; Bosman, van Hell, & Verhoeven, 2006; Hilte & Reitsma, 2006; Schiffelers, Bosman, & van Hell, 2002 for Dutch; Ormrod & Jenkins, 1989 for English). Overpronunciation is regularizing the spelling of words by reading the particular word aloud according to prototypical grapheme-to-phoneme relationships. An example is reading the word WEDNESDAY as /wed/ /nes/ /day/. This approach is particularly effective for the memorization of strange words. Although poor spellers need more practice than good spellers, overpronunciation is effective for both groups of spellers (Bosman, van Hell, & Verhoeven, 2006; Schiffelers et al., 2002). Thus, memorization of word lists could be a part of the spelling instruction (Graham, Harrix, & Loynachan, 1994), but it is not really effective if rules determine the spelling. Moreover, spellers may develop the belief that learning to spell is a word-by-word process (Berninger et al., 1998; Henry, 1989).

Spelling rules enable spellers to spell novel words that contain the same spelling rule as known or practiced words. Spelling rules can be derived from phonological, morphological, and/or orthographic principles of a language, but spellers can also be taught to spell particular words by analogy to other words.

Spelling by analogy is to spell inconsistent words according to the common rimes of key words (for example, TONIGHT, WAIT, and WISH). There is, however, a caveat with respect to spelling by analogy. Only when a speller knows the spelling of the keyword, will (s)he know how to spell the analogous word. For example, one has to know that the word LIGHT has to be spelled just like TONIGHT and not like KITE. On the basis of just the sound structure of a word, spellers are unable to determine according to the analogy of which word an inconsistent word has to be spelled. Thus, learning the spelling based on the application of rules appears a safer bet.

Rules can be taught explicitly (Butyniec-Thomas & Woloshyn, 1997; Darch, Eaves, Crowe, Simmons, & Conniff, 2006; Hilte & Reitsma, 2011; Kemper, Verhoeven, & Bosman, 2012). Explicit rule instruction is effective for both poor and good spellers (Butyniec-Thomas & Woloshyn, 1997; Hilte & Reitsma, 2011; Kernaghan & Woloshyn, 1995 for average or good spellers; Graham, Harris, & Chorzempa, 2002 for poor spellers; Darch et al., 2006; Kemper, Verhoeven, & Bosman, 2012 for students from special education). Hilte and Reitsma (2011) and Kemper et al. (2012) compared an implicit-instruction condition in which spellers practiced with words, but did not learn the underlying spelling rule explicitly, with an explicit-instruction condition in which spellers were taught the spelling rule. For words with an orthographic rule, both conditions were equally effective for both poor and good spellers (Hilte & Reitsma, 2011; Kemper et al., 2012). For words with a morphological rule, the explicit condition was more effective than the implicit condition for good spellers, but not for poor spellers (Kemper et al., 2012). Good spellers in the explicit condition generalized their knowledge of the rule to untrained pseudowords, unlike poor spellers. The transfer problem for poor spellers was confirmed by Bosman, van Huygevoort, and Verhoeven (2006), who showed that transfer effects were stronger in good than in poor Grade-2 spellers. Gerber (1985, 1986), however, showed that poor spellers were also able to generalize their knowledge of trained words to new words. Thus, when spellers learn spelling rules, they become able to spell inconsistent words belonging to that particular word category correctly.

With respect to the teaching of a structured approach that can be used to spell inconsistent words of multiple word categories correctly, previous research has shown that explicit instruction of such an approach is effective to enhance the spelling performance of both poor (Paffen & Bosman, 2005) and good readers/spellers (Butyniec-Thomas & Woloshyn, 1997; Kernaghan & Woloshyn, 1995; Paffen & Bosman, 2005). Teaching a structured approach for the spelling of words may involve the teaching of one or more spelling rules in combination with another approach such as syllable segmentation (Butyniec-Thomas & Woloshyn, 1997). Willemen, Bosman, and van Hell (2000, 2002) showed the effectiveness of teaching a structured approach for self-correction for both poor (i.e., students with learning

disabilities) and good spellers. Good spellers already profited from examining their spelling after they had finished their free writing assignment, whereas poor spellers did not. Note that, both poor and good spellers profited from the self-correction training. Various studies have shown the positive effects of self-correction on spelling performance for spellers in general education (McGuffin, Martz, & Heron, 1997; Willemen et al., 2000; Wirtz, Gardner, Weber, & Bullara, 1996), special education (Grskovic & Belfiore, 1996), and for spellers with learning disabilities in middle school (McNeish, Heron, & Okyere, 1992). Gettinger (1985) showed that poor spellers made more progress when they had to detect their spelling errors themselves and had to self-correct them, than when their teacher marked the errors. An important aspect of (self-)feedback for both poor and good spellers is that it is given immediately after dictation (Harward, Allred, & Sudweeks, 1994; Kearney & Drabman, 1993). Various studies showed equal effects of feedback for poor and good spellers (Gerber, 1986; van Oudenhoven, Siero, Veen, & Siero, 1982).

Moreover, with respect to spelling consciousness, research has shown that spelling instruction that focused on improving the spelling consciousness of spellers appeared to be effective for both poor and good readers/spellers (Paffen & Bosman, 2005; Willemen et al., 2002). Poor and good readers/spellers had a similar increase in spelling consciousness after training (Paffen & Bosman, 2005). An example of an approach that was effective for improving both spelling consciousness and spelling performance was provided by the study of Paffen and Bosman (2005). Their training included the teaching of meta-cognitive strategies, but also the teaching of a structured approach to spell words correctly. For this approach, spellers have to listen carefully to the word, segment the word into syllables, and think for each syllable about the spelling rules that have to be applied to spell that syllable correctly.

To summarize, explicit instruction is effective for both poor and good spellers. Although there are differences between the various studies, it seems that many different instruction methods are effective for both poor and good spellers. This was true for instruction with respect to memorization of irregular words, teaching a spelling rule, teaching a structured approach to spell words of multiple word categories correctly, and stimulating spelling consciousness. However, the question raises which instruction method is both effective and efficient at the same time.

The Present Research

Educational background

The Dutch language is rather transparent for reading, whereas it is relatively opaque for spelling (Bosman, de Graaff, & Gijsel, 2006). In other words, the grapheme-to-phoneme relationships are more consistent than the phoneme-to-grapheme

relationships. That is, there are more possible ways to spell a word than to pronounce a word during reading. For example, the Dutch words MEIDEN [girls] and MIJDEN [to avoid] are both pronounced as /mɛidən/. The phoneme /ɛi/ can be written in two ways, as EI or IJ. However, many of these inconsistent words, of which there are a lot more in English than in Dutch, can be written correctly with a limited set of spelling rules (Nunn, 1998). As discussed above, there are phonological, morphological, and orthographic spelling rules that can be applied to spell inconsistent words correctly. With respect to a phonological rule, the Dutch language contains, for example, both nouns and verbs with /w/, /ew/, or /iw/, that are spelled as UW, EEUW, or IEUW. The U before the W is not pronounced (e.g., DUW [push], LEEUW [lion], and NIEUW [new]). An example with respect to a morphological rule is that the Dutch language contains nouns with a final /p/-sound that in some words has to be written as a P and in other words as a B, depending on the plural form of the word. For example, the plural form of the word /lɑmp/ [lamp] is /lɑmpən/, so the singular form is LAMP with a final P, whereas the plural form of the word /wɛp/ [web] is /wɛbən/, so the singular form is WEB with a final B. Dutch orthographic rules, however, are artificial in nature because they are not based on phonology, but are made up by spelling reformers (Nunn, 1998). Consequently, these rules are more complicated to apply. For example, in the Dutch language there is a consonant-doubling rule for polysyllabic words with a short vowel. The rule states that a consonant after a short vowel has to be doubled in case of a closed syllable. Monosyllabic words with a short vowel are often followed by a single consonant, for example, in KAT [cat] the short vowel A is followed by a single consonant T. The plural form of KAT is KATTEN, in which the A is still a short vowel, and to keep this short, the consonant T after the A has to be doubled.

In the Netherlands, most kindergarten teachers use some early literacy activities to stimulate phonological awareness and letter knowledge in both first and second year of kindergarten (van Druenen, Gijsel, Scheltinga, & Verhoeven, 2012). In first grade, most schools use an educational method in which reading and spelling are integrated, whereas after first grade, a separate method for spelling is used. In most spelling methods, children have four or five spelling lessons of 20-25 minutes every week (e.g., Taal Actief [Language Active] de Geus, Janssen, & van Ooijen, 2013; Staal [Steel] Groot & Nederkoorn, 2013). The school year is divided into blocks of a couple of weeks each. In every block, a new spelling category is introduced and previously learned spelling categories are repeated. Spelling categories are often introduced with a story that contains words with that specific category, followed by a discussion about the particular category, in which children have to think of other words within that same category. In the upcoming weeks, the children practice with words of that particular category by making spelling-to-dictation tasks and making assignments in their workbook.

The present thesis

In the present thesis, three aspects of spelling are examined: precursors of spelling (Part I), spelling acquisition (Part II), and spelling instruction (Part III). To provide all children with effective spelling instruction, the effect of individual variation has to be taken into account. It first has to be established what the most important predictive skills for spelling are and whether these precursors are the same for various groups of spellers. Therefore, Part I contains a chapter about the precursors of spelling (Chapter 2). In Chapter 2, the precursors of spelling are examined for a group of children at risk for developing spelling problems, namely, children with Specific Language Impairment (SLI; Nauclér, 2004). Children with SLI fail to acquire their native language despite at least average non-verbal intelligence, adequate hearing and vision, no known neurological, physical, emotional or social problems, and adequate opportunity to acquire language skills (McArthur & Bishop, 2001). A large number of children with SLI develop spelling problems that are persistent and remain stable over time (Snowling, Bishop, & Stothard, 2000; van Weerdenburg, Verhoeven, Bosman, & van Balkom, 2011). We investigated which skills were the most accurate precursors for spelling problems at the end of Grade 1. When the important precursor skills for children at risk for spelling problems are established, the spelling acquisition of children can be taken into account.

Part II consists of two chapters in which the spelling acquisition of children at risk for spelling problems (i.e., children with SLI) is compared with that of average or good spellers (i.e., children with a typical language development; Chapters 3 and 4). In Chapter 3, the speed, nature, and knowledge transfer with respect to spelling of first grade children with SLI are examined. The speed was examined by comparing the tempo in which children with SLI learn to spell with that of typically developing children (according to Dutch norms). The nature of spelling was investigated by examining whether the orthographic characteristics that influence early spelling of typically developing children (i.e., type of grapheme, grapheme position, number of graphemes, and word structure) also predict spelling of children with SLI. Knowledge transfer was examined by verifying whether children with SLI generalize their knowledge of isolated graphemes in using these graphemes during the spelling of words. In Chapter 4, it was examined whether the spelling acquisition of first grade children with SLI was quantitatively and qualitatively different from that of typically developing children. A quantitative difference would indicate that children with SLI only have a delay in spelling, whereas a qualitative difference would indicate that children with SLI also show a different order in spelling acquisition than typically developing children.

Part III consists of three chapters about spelling instruction. In Chapter 5, we focused on the instruction of spelling rules. The effects of implicit and explicit

instruction on the spelling of words with a morphological or a phonological rule were examined for typically developing children in Grade 1. In Chapters 6 and 7, the effect of structured spelling instruction for the spelling of inconsistent words was examined on both spelling performance and spelling consciousness. In Chapter 6, the immediate and sustained effects of teaching a structured approach to correct one's spelling, self-correction, and no correction were compared for typically developing children from Grade 3. The structured approach included segmentation of a word into syllables and naming and using the spelling rule(s) that could be applied to each syllable. In Chapter 7, we examined the role of instruction for typically developing children in Grade 3. The benefits of metacognitive practice on both spelling performance and spelling consciousness were examined by comparing the effects of strategy instruction, strategic monitoring, and self-monitoring. We tested the role of instruction across word types (regular vs. irregular words), instruction types (strategy instruction vs. strategic monitoring vs. self-monitoring), and types of spellers (low skill vs. high skill). In all chapters of Part III, we took into account differences between low- and high-skilled spellers, to examine whether the same spelling-instruction methods can be used for good as well as for poor spellers.

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Part I

Precursors

Chapter 2

Predicting early spelling difficulties in children with Specific Language Impairment: A clinical perspective

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This chapter has been published as:
Cordewener, K. A. H., Bosman, A. M. T., & Verhoeven, L. (2012).
Predicting early spelling difficulties in children with Specific Language Impairment:
A clinical perspective.
Research in Developmental Disabilities, 33, 2279-2291.

Abstract

This study focused on the precursors of spelling difficulties in first grade for children with specific language impairment (SLI). A sample of 58 second-year kindergartners in the Netherlands was followed until the end of first grade. Linguistic, phonological, orthographic, letter knowledge, memory, and nonverbal-reasoning skills were considered as precursors, as was spelling level at an earlier point in time. Spelling difficulties at the end of first grade were most accurately identified by letter knowledge at the beginning of first grade and word spelling at the middle of first grade. It is concluded that spelling development in children with SLI can be seen as an autocatalytic process in which, without intervention, poor spellers generally remain poor spellers, and good spellers remain good spellers. A focus on early spelling intervention is thus emphasized.

Predicting Early Spelling Difficulties in Children with Specific Language Impairment: A Clinical Perspective

Children with specific language impairment (SLI) have a failure in their language development, despite at least average non-verbal intelligence, adequate hearing and vision, no known neurological, physical, emotional or social problems, and adequate opportunity to acquire language skills (McArthur & Bishop, 2001). The failures can be receptive and/or expressive, and arise in different areas of communication; phonology, morphology, syntax, semantics, and/or pragmatics (Botting & Conti-Ramsden, 2004). As a consequence of their language delay (Bishop, 1992; Leonard, 1998), children with SLI are at risk for the development of spelling difficulties (e.g., Nauclér, 2004). A large number of children and adults with SLI indeed exhibit spelling problems that are persistent and remain stable over time (e.g., Snowling, Bishop, & Stothard, 2000; van Weerdenburg, Verhoeven, Bosman, & van Balkom, 2011). To alleviate or even prevent the development of spelling problems, early identification and intervention may provide a solution. Research on the precursors of spelling difficulties is necessary to make early identification possible.

Previous research with typically developing children indicates that letter knowledge, phonological awareness, working memory, and rapid naming are precursors of early spelling. This is shown in Table 1. Letter knowledge is one of the most important precursors of the development of spelling knowledge (Caravolas et al., 2001; Furnes & Samuelsson, 2010; Lervåg & Hulme, 2010; Muter et al., 1998; Ouellette & Sénéchal, 2008), because it is frequently found in various studies. This is not surprising, because spelling in an alphabetical language requires the knowledge of all graphemes (i.e., letters or letter clusters) that represent the phonemes of the language.

Phonological awareness is a second major precursor of spelling of typically developing children, because it is frequently found in different studies (Bradley & Bryant, 1983; Caravolas et al., 2001; Furnes & Samuelsson, 2010; Lervåg & Hulme, 2010; Muter et al., 1998; Ouellette & Sénéchal, 2008; Stage & Wagner, 1992). Phonological awareness is a broadly defined concept and the reviewed studies (see Table 1) reveal that a large number of different tasks have been used to measure phonological awareness. We define phonological awareness as the ability to segment words into their phonemes, because this phoneme segmentation is a prerequisite for spelling (Bosman, 2004). To be able to spell, one has to divide a word into its phonemes and have to connect each phoneme to its corresponding graphemes, before the words can be written down.

Table 1 Overview of the Kindergarten Precursors of Spelling in Typically Developing Children

Study	Task/precursors	Factor	R^2
Bradley & Bryant (1983)	Sound categorization	Phonological awareness	.06 - .08
Stage & Wagner (1992)	Sound categorization	Phonological awareness	
	Letter span	Working memory	
Muter, Hulme, Snowling, & Taylor (1998)	IQ Phoneme identification + phoneme deletion Letter naming	Intelligence Phonological awareness Letter knowledge	.14 - .18 .16 - .36 .19 - .30
Caravolas, Hulme, & Snowling (2001)	Phoneme isolation	Phonological awareness	
	Letter-name and letter-sound knowledge	Letter knowledge	
	Phonological spelling	Spelling	
	Word reading	Reading	
Ouellette & Sénéchal (2008)	Letter-name and letter-sound knowledge	Letter knowledge	.37 - .44
	Isolating and comparing phonemic segments, elision, blending words	Phonological awareness	.36 - .41
	Visual recognition of legal characters, visual recognition of permissible sequences within words	Orthographic awareness	.08 - .19
	Comprehension of grammatical morphemes	Morphology	.11 - .18
Furnes & Samuelsson (2010)	Syllable and phoneme blending, word elision, syllable and phoneme elision, sound matching, rhyme and final phoneme matching, phoneme identity training test	Phonological awareness	
	Receptive letter knowledge	Letter knowledge	
	Rapid naming of objects and colours	Rapid naming	
Lervåg & Hulme (2010)	Rapid naming of objects and colours	Rapid naming	
	Phoneme isolation, phoneme deletion	Phonological awareness	
	Letter naming	Letter knowledge	
	Verbal short-term memory	Working memory	

Working memory is a third precursor of spelling of typically developing children (Lervåg & Hulme, 2010; Stage & Wagner, 1992). Working memory is considered to include both temporary storage and processing of information. The relatively heavy demand that spelling tasks put on working memory processes might be an explanation for the predictive value of working memory (Lervåg & Hulme, 2010). To be able to spell, one has to keep track of the coupling of phonemes to graphemes in the right order. If this process does not proceed properly, spelling may be hampered.

A fourth precursor of spelling of typically developing children is rapid naming (Furnes & Samuelsson, 2010; Lervåg & Hulme, 2010). Rapid naming involves the retrieval of lexical phonological representations from long-term memory (Ramus & Szenkovits, 2008). To spell a word, lexical phonological information has to be retrieved from memory.

Not all precursors of spelling of typically developing children predict spelling of children with SLI. Vandewalle, Boets, Ghesquière, and Zink (2010) investigated the precursors of spelling of children with SLI at the end of first grade. Letter knowledge, phonological awareness (rhyme production, end rhyme identity, first sound identity task, and end sound identity task), and verbal short-term memory in kindergarten did not predict spelling performance very well at the end of first grade. Rapid, automatized naming in kindergarten, however, was strongly correlated with spelling in first grade. This shows that what is the case for typically developing children, may not be the case for children with SLI. It is, therefore, warranted to investigate the precursors of early spelling of children with SLI.

Although letter knowledge, phonological awareness, working memory, and rapid naming predicted spelling of typically developing children, the predictive value of these skills is generally limited to the first year of formal spelling instruction. Caravolas et al. (2001) found that during the first one and a half year of education, spelling was predicted by letter knowledge and phonological awareness, whereas letter knowledge and phonological awareness had no predictive value for spelling skills when children were in second grade. Lervåg and Hulme (2010) reported similar results: Rapid naming, phonological awareness, letter knowledge, and short-term memory predicted early spelling skills, but only early spelling skills predicted further growth in spelling skills.

Because the precursors of spelling in children with SLI are not yet clear, we used a large battery of possible precursors for spelling difficulties to investigate this issue. Because children with SLI generally have poor linguistic, phonological, and memory skills, we also took into account orthographic skills. Orthographic awareness is the ability to visually recognize legal symbols and patterns within printed words (Mather & Goldstein, 2001). By measuring phonological skills in kindergarten, we made sure that these skills were not yet influenced by spelling

abilities. The skills that are precursors of spelling according to previous studies, most often only partially predict spelling, and the predictive value is limited to a short period of time. Because the precursors of spelling of children with SLI are still unclear, in our study, we used a longitudinal design with a large number of precursors. We followed children from the second year of kindergarten until the end of first grade. We took into account linguistic, phonological, orthographic, letter knowledge, memory skills, and nonverbal reasoning, but also spelling level at an earlier point in time.

We chose these precursors, because children with SLI are known to have problems with linguistic skills, like for example articulation, and with phonological skills, like phoneme identification (Bishop, 1997). Vandewalle et al. (2010) showed that children with SLI could also have problems with letter knowledge. Children with SLI may differ from typically developing children with respect to memory skills, like verbal sequential memory (van Weerdenburg, Verhoeven, & van Balkom, 2006), and nonverbal-cognitive abilities (Ellis Weismer, Evans, & Hesketh, 1999). Children with SLI have lower scores on these precursor skills than typically developing children. We took into account spelling level, because Lervåg and Hulme (2010) showed that spelling was best predicted by spelling level at an earlier point in time. Orthographic knowledge acquired during kindergarten is a new variable that has not been tested before in this group. However, previous research showed that orthographic knowledge predicted spelling of typically developing children (Ouellette & Sénéchal, 2008). Therefore, this variable was also included as precursor in this study.

The aim of the present study was twofold. The first goal was to assess the discriminatory power of each of the before mentioned tests, that is, to what extent can each test reliably distinguish between good and poor spellers with SLI. The second goal was to assess which of the precursors, a set of related tests, best predicts spelling difficulties in children with SLI.

Method

Participants

This study was conducted with children who attended special-education schools for children with SLI in the Netherlands. Three different schools with second-year kindergartners were invited to participate in order to obtain a sufficient number of children.[1] Deaf and hearing-impaired children were excluded from the study.

1 No differences exist between the test scores of children from the different schools, except for the tests: *awareness of written language*, and *phoneme spelling* and *word spelling* at the end of first grade. Children of school A had lower scores on *awareness of written language* than children of school B

Because of illness or absence, 20 children were excluded.[2] The final sample consisted of 58 kindergartners (21 girls, 37 boys) between the ages of 64 and 90 months (M = 75;5, SD = 6;0). The over representation of boys is typical for children with SLI (Robinson, 1991). All participating children spoke Dutch. Most children had Dutch as their native language. However, there were some children with a mother tongue different than Dutch; six children spoke Turkisch at home, one child spoke Moroccan at home, one child spoke Arabic at home, and five children spoke both Dutch and another language at home.

Materials

This section covers the different tests that were used to measure linguistic, phonological, orthographic, letter knowledge, and memory skills, and nonverbal reasoning and spelling skills.

Linguistic skills

Linguistic skills were assessed on three different aspects. The first one was *Linearity of spoken language awareness*, measured by the subtest 'Laatste en eerste woord horen' [Hearing the last and first word] from Taal voor Kleuters [Language for Kindergartners] (van Kuyk, 1996). The child was presented with four drawings and had to point to the one that corresponded with the first or last word spoken by the experimenter. The score equaled the number of correct responses. The lowest possible score was zero and the highest possible score was eight.

The second one was *Articulation skills*, measured by the 'Utrechts Articulatie Onderzoek, verkorte vorm 5;0-6;0 jarigen' [Utrecht's articulation research, short version for children of 5;0-6;0 years old] (Peddemors-Boon, van der Meulen, & de Vries, 1977). The child received a booklet and had to name the image on each page. Examples of items were *'fles' [bottle]* in which the phoneme cluster */fl/* had to be pronounced correctly and *'heks' [witch]* in which the phoneme cluster */ks/* had to be pronounced correctly. Each of the 44 items contained a consonant or a combination of consonants that had to be pronounced correctly. Each consonant or combination of consonants appears in pairs across successive items. The reliability of this test was .87 (Peddemors-Boon et al., 1977). The score equaled the number of correctly pronounced consonants or combinations of consonants. The lowest possible score was 0 and the highest possible score was 44.

and C (p's < .01). Children of school B had lower scores on *phoneme spelling* than children of school A (p < .05). Children of school B scored lower on *word spelling* than children of school A and C (p's < .01).

2 The scores of the group of children that dropped out of the study did not differ significantly from the scores of the remaining group on the tasks that were administered at kindergarten, but they were significantly younger (M = 71;5) than the group that participated in the study (M = 75;6) (p < .01).

The third one was *Rapid naming* by means of the subtests color naming, number naming, and picture naming of the test 'Serieel Benoemen en Woorden Lezen' [Serial Naming and Word Reading] (van den Bos, 2004). The child had to name colors, numbers, and pictures as quickly and as accurately as possible. The card with colors contained squares in the colors black, yellow, red, green, and blue. The card with numbers contained the numbers two, four, eight, five, and nine. The card with pictures contained pictures of a tree, duck, chair, pair of scissors, and a bicycle. Each card consisted of five rows with ten items each. The five different items on each card were all repeated ten times in a random order. The reliability of this test for children at the age of seven is .80 for the naming of colors, .84 for the naming of numbers, and .78 for the naming of pictures (van den Bos, 2004). The experimenter recorded the time it took the child to name the colors, numbers, and pictures. A limited number of naming errors are accepted, children with more than 15 errors on color naming, 20 errors on number naming, or 4 errors on picture naming, were removed from the analysis of the particular task (more than 3 *SD* above the mean).

Phonological skills

Phonological skills were assessed on two different aspects: *Sound awareness and rhyming skills*, measured by the subtest 'Klank en rijm' [Sound and rhyme] from Taal voor Kleuters [Language for Kindergartners] (van Kuyk, 1996). The experimenter named the four drawings for each item and gave the instruction. On the sound-awareness items, the child had to point to the drawing with a particular first sound, or the two drawings with a similar first sound. On the rhyme items, the child had to point to the drawing that rhymed with a particular word, the drawing that did not rhyme, or the drawings that rhymed with each other. The score equaled the number of correct items. The test consisted of four sound-awareness items and four rhyme items; the lowest possible score was zero and the highest possible score was eight.

Auditory synthesis was measured by two tests. The first one was *Auditory synthesis I,* measured by the subtest 'Auditieve synthese' [Auditory synthesis] from Taal voor Kleuters [Language for Kindergartners] (van Kuyk, 1996). The child had to point to the drawing corresponding to the word that was named in isolated sounds. For instance, the instruction of the experimenter was: 'Point at the */s/-/o/-/k/ [sock]*'. The child had to choose the correct drawing out of four drawings. The score equaled the number of correctly synthesized items. The lowest possible score was zero and the highest possible score was eight.

The second test was *Auditory synthesis II*, a modification on *Auditory synthesis I*. The child had to point to the drawing corresponding to the word that was sounded out by the experimenter such that each phoneme was pronounced extendedly and

smoothly turned into the next. For instance, the instruction of the experimenter was: 'Point at the *ssssooookkk [sock]*'. The items were the same as in *Auditory synthesis I*. The score equaled the number of correct items. The lowest possible score was zero and the highest possible score was eight.

Orthographic skills

Orthographic skills were assessed on three different aspects. The first one was the *Awareness of written language*, which was measured by the subtest 'Schriftoriëntatie' [Awareness of written language] from Taal voor Kleuters [Language for Kindergartners] (van Kuyk, 1996). The task contained eight items. One item in which the child had to choose the letter out of a number, letter, word, and sentence; two items that consisted of a sentence in which the child had to underscore a particular part of the sentence; one item that consisted of a word, in which the child had to underline the grapheme in the middle; three items that consisted of four drawings, in which the child had to choose the drawings that were related to written language (for instance, choosing drawings containing words, like a news paper, a book or a letter); and one item that consisted of twelve graphemes in which the child had to underline all graphemes that were the same as the first grapheme. The score equaled the number of correct items. The lowest possible score was zero and the highest possible score was eight.

The second one was *Letter-symbol distinction*, measured by a computer task. A stimulus appeared on the computer screen, after which the child had to decide whether the stimulus contained only real letters or had letters and a symbol. The child responded by pushing a green or red key on a box. If the stimulus contained only real letters, the children had to push the green button. If there was a symbol that was not a letter in the string, the children had to push the red button. The score equaled the number of correct items. The lowest possible score was zero and the highest possible score was 60.

In this task, sixty stimuli were used: Thirty letter strings and thirty strings with both letters and a symbol. Each string contained between two and four signs. The letters in a particular string were all vowels or consonants. Because of the large amount of stimuli, the stimuli were distributed over two lists. Prior to the test items, there were five practice items for each list. These items were used to provide the children with feedback on their responses. When a child did not understand the instruction, it was repeated, until the child understood the instruction. Half of the children started with the first list and the other half with the second list. Appendix A presents the stimuli used in the letter-symbol distinction task.

The stimuli were presented in lowercase letters using 40 point, Arial Black font. Each trial started with a fixation point in the center of the screen (a plus-sign,

18 point, Arial bold) that was presented for 1000 ms prior to the presentation of the stimulus. The stimuli then appeared and remained on the screen until the child responded by pushing the green or red button. The keys on the button box were arranged in such a way that the green key appeared on the right for right-handed children and the left for left-handed children. The software program E-prime controlled stimulus presentation, stimulus randomization, response latency registration, and data recording.

The third assessment of orthographic knowledge was *Wordiness judgement*. It was measured by a task in which each item contained three stimuli; a pseudoword, a nonword, and a string of letters with a symbol each containing two to four characters. Pseudowords were non-existing words that consist of an orthographically legal letter string, for example *'nit'* or *'biek'*. The pseudowords were matched with existing words in their bigram frequencies. Nonwords consisted of orthographically illegal letter strings, for example *'hvk'* or *'oaau'*. Pseudowords are pronounceable and nonwords are not. An example of a string of letters with a symbol is *'%oe'* or *'hj#'*. The children had to point to the stimulus that looked most like a real word.

The stimuli were presented on paper in lowercase using 40 point, Arial Black font. Each item was presented on a separate piece of paper. There were fifteen different item orders. However, the order of the stimuli (pseudoword, nonword, string of letters with a symbol) within each item remained the same in each of the different item orders. Prior to the task, there were four practice items. These items were used to provide feedback to the children. Appendix B presents the stimuli used in this task. The score was computed by multiplying the number of times the child pointed to a pseudoword by three, multiplying the number of nonwords by two, and the number of strings of letters with a symbol by one. We have chosen for this scoring system because pseudowords are strings that have a legal ordering of letters, but do not have meaning. Nonwords are strings with illegal ordering of letters and no meaning. Letter strings contain symbols and additional illegal elements. The lowest possible score was 30 and the highest possible score was 90.

Letter knowledge

Letter knowledge was assessed with both *Letter reading* and *Phoneme spelling*. The first one, *Letter reading*, was measured with a computer task. A letter appeared on the computer screen, after which the child had to provide the letter sound. Responses were recorded by a voice key. The stimuli were presented in lowercase letters of Arial Black font, point size 72. The 'a' and the 'aa' were also presented in lowercase letters of Berlin Sans FB Demi font like '**ɑ**' and '**ɑɑ**', point size 72, because the way in which these graphemes were presented to the child depends on the educational method. This task contained 36 stimuli: consonants, vowels, and digraphs. After

18 stimuli there was a pause and the child was able to decide when he or she was ready to start with the second block of stimuli. There were two different lists with the same stimuli, but in different order. List 1 started with Block 1 followed by Block 2; the second list started with Block 2 followed by Block 1. Half of the children started with List 1 and the other half started with List 2. Prior to the task proper, children were presented with five practice items. These practice items were digits, because all graphemes were included in the real task, so we could not include graphemes as practice items. Appendix C presents the graphemes used in the letter-reading tasks. The score equaled the number of correctly named graphemes. Because all 36 graphemes appeared twice, the lowest possible score was zero and the highest possible score was 72. Sometimes a child made a noise that set off the voice key inadvertently and, caused the grapheme to disappear from the screen before the child was able to name the grapheme. To make sure that all children were able to name each grapheme, all graphemes were presented twice.

The letter was located at a fixed point in the center of the screen using 72 point, Arial Black font. Each trial started with a fixation point in the center of the screen (a plus-sign, 46 point, Arial) that was presented for 750 ms prior to the presentation of the stimulus. After the fixation point, there was a delay of 150 ms before the letter was presented at a fixed point in the middle of the screen. The stimuli then appeared and remained on the screen until the child named the letter. Naming times were registered with a voice key. The voice key was a microphone that registered the time between the appearance of the stimulus on the screen and the first noise that was made. The experimenter evaluated and recorded correctness of the response by pushing a key on the button box, which initiated the next item. The software program E-prime controlled stimulus presentation, stimulus randomization, response latency registration, and data recording.

The second letter-knowledge task was *Phoneme spelling*, which required the child to write each grapheme that corresponds to the phoneme named by the experimenter. The experimenter named the isolated phoneme and mentioned a word that contained the target phoneme. Children did not have to segment the word, because the experimenter also named the target phoneme isolated from the word. They just had to write down isolated graphemes. Appendix D presents the graphemes used in this test. In the test for Letter reading, we used 36 graphemes because the 'a' and the 'aa' were also presented as '**ɑ**' and '**ɑɑ**'. In school books, both graphic representations of the same phoneme are used. Therefore, each representation was presented in the test for Letter reading. Consequently, for Phoneme spelling, we only had 34 graphemes, because the 'a' and the 'aa' were only presented once. The score equaled the number of correctly written graphemes. The lowest possible score was zero and the highest possible score was 34.

Memory skills

Memory skills were assessed on three different aspects. The first one was an indication of *Long-term memory* measured by the '12-woordentest' [12-words test], an adaptation by Braams and Partners of the '15-woordentest' [15-words test] developed by Kalverboer and Deelman (1964). Three single words were removed from the original test; the remaining twelve consisted of six pairs, words related by category (for instance, tulip and rose). The child had to remember words that were named by the experimenter. Appendix E presents the words used in this test. The task started with the experimenter naming all twelve words. The child was asked to repeat all the words he or she remembered. After the first trial, the second trial started with the experimenter naming all twelve words once more and again the child was asked to repeat the words he or she remembered. The same procedure was repeated in a third, fourth, and fifth trial. After twenty minutes, the recall trial was presented. Without the experimenter repeating the words, the child was asked to name all the words he or she still remembered from the first five trials. The score equaled the number of words the child named in the recall session, with the lowest possible score being zero and the highest possible score 12.

The second assessment of memory skills was *Short-term memory*, which was measured by the subtest 'Digit recall' from the Dutch version of the Wechsler Intelligence Scale for Children-III (Wechsler, 2005), which required the child to repeat a string of digits spoken by the experimenter. For example, the experimenter named the string '4 6 9', after which the child had to repeat this string by saying '4 6 9'. The first two strings contained three digits, the following two strings contained four digits to a maximum of nine digits. The test was terminated when a child failed on two consecutive items with the same number of digits. The score was the number of correctly named strings. The lowest possible score was zero and the highest possible score was 18.

The third assessment of memory skills was *Working memory* measured by the subtest 'Backward digit recall' of the Dutch version of the Wechsler Intelligence Scale for Children-III (Wechsler, 2005). The procedure for 'backward digit recall' was almost the same as for 'digit recall'. But, in contrast to 'digit recall', the child had to repeat the string backwards. For instance, the experimenter named the string '8 3 5', after which the child had to say '5 3 8'. The construction of the strings was the same, but the maximum string length was eight digits. Prior to the 'backward digit recall', there were two practice items. The lowest possible score was zero and the highest possible score was 16. The reliability of 'digit recall' and 'backward digit recall' was .79 for children at the age of six years and six months old (Wechsler, 2005).

Nonverbal reasoning

Nonverbal reasoning was assessed by *Nonverbal-deductive reasoning* measured by the 'RAVEN's Standard Progressive Matrices' (Raven, 2003). The test contains 60 items in five sets. Each item included a figure with a missing piece. The child had to choose the correct piece out of six or eight possible pieces. Appendix F presents an example of the RAVEN (Raven, Raven, & Court, 1998). The score equaled the number of correctly identified pieces. The lowest possible score was zero and the highest possible score was 60.

Spelling skills

Spelling skills were measured by the 'Schaal Vorderingen in Spellingvaardigheid 1 Dictee 2' [Scale Progression in Spelling Abilities 1 Dictation 2] (van den Bosch, Gillijns, Krom, & Moelands, 1991). The child had to write monosyllabic words that had consistent phoneme-to-graphemes relations. The monosyllable words had a 'VC' (vowel-consonant), 'CVC', 'CCV', 'CCVC', or 'CVCC' structure. The score equaled the number of correctly spelled words. For each word, the number of correctly written graphemes was computed and divided by the number of graphemes within that word. Because the test contained 22 items, the lowest possible score was zero and the highest possible score was 22.

Procedure

Letters were sent to the school administration of special-education schools for children with SLI, inviting them to participate in the study. Reply forms were attached with the letter. A few weeks later, the schools were also contacted by phone.

The first author administered the tests individually with the help of research assistants. All individual test sessions took place in a separate quiet room in the school. Three tests, nonverbal-deductive reasoning, letter and word spelling were administered group wise. Table 2 presents the time-table for each test that was administered.

Data analysis

To investigate the discriminatory power of all variables, we first calculated percentages of valid and false positive and negative outcomes. Secondly, we computed the sensitivity and specificity indexes. Thirdly, we performed an ANOVA analysis. Finally, a logistic regression analysis was performed to examine which combination of precursors discriminated best between poor and typical spellers.

We defined the 25% children that had the lowest scores on the precursors to be at risk for spelling difficulties. The 25% lowest scoring children on spelling were indicated as poor spellers. We chose the 25% lowest scoring children as scoring below standard, because this criterion is also used in Dutch standardized tests.

Table 2 Overview of the Different Tests Used at Each Moment of Measurement

	Kindergarten	Grade 1		
	February 2008	October 2008	January 2009	May 2009
Linguistic skills				
Linearity of spoken language awareness	x			
Articulation		x		
Rapid naming			x	
Phonological skills				
Sound awareness and rhyming	x			
Auditory synthesis I	x			
Auditory synthesis II	x			
Orthographic skills				
Awareness of written language	x			
Letter-symbol distinction	x			
Wordiness judgement	x			
Letter knowledge				
Letter reading	x			
Phoneme spelling		x		
Memory skills				
Long-term memory		x		
Short-term memory		x		
Working memory		x		
Nonverbal reasoning				
Nonverbal-deductive reasoning			x	
Spelling				
Word spelling			x	x

Before the letter-symbol distinction and letter-reading data were analyzed, the following responses were removed from the data set: naming errors, errors due to voice-key failure, extremely short responses (less than 250 ms), and extremely long responses (more than 3 *SD* above the participants' mean). For the analyses of the rapid naming, letter-symbol distinction, and letter-reading tests, reaction times were recoded so that longer times indicated better performance.

Results

Descriptive Statistics

Means and standard deviations on the different tests are shown in Table 3.

Table 3 Overview of the Descriptive Statistics on the Precursor Tests

	N	Highest possible score	25th percentile	M	SD
Linguistic skills					
Linearity of spoken language awareness	51	8	4	5.8	2.1
Articulation	58	44	34	36.4	7.1
Rapid naming Colors	53		170.0	184.6	21.0
Rapid naming Numbers	55		132.0	146.0	28.7
Rapid naming Pictures	56		45.6	55.3	23.7
Phonological skills					
Sound awareness and rhyming	51	8	2	4.3	2.0
Auditory synthesis I	51	8	4	5.7	1.9
Auditory synthesis II	25	8	6	7.0	1.4
Orthographic skills					
Awareness of written language	51	8	3	5.0	2.1
Letter-symbol distinction - score	52	60	45	49.8	8.4
Letter-symbol distinction - reaction time	51		3647.2	4017.7	636.8
Wordiness judgement	54	90	63	69.7	8.3
Memory skills					
Long-term memory	58	12	0	3.0	2.5
Short-term memory	58	18	3	4.5	1.2
Working memory	58	16	0	1.1	1.2
Nonverbal reasoning					
Nonverbal-deductive reasoning	58	60	14	20.7	8.2
Letter reading					
Score	52	72	12	22.9	13.7
Reaction time	47		1424.3	1622.8	421.4
Phoneme spelling					
Phoneme spelling	58	34	12	16.6	6.5
Word spelling					
Middle of first grade	58	22	5.8	12.7	6.6
End of first grade	58	22	14.5	16.8	5.3

Predicting Early Spelling Difficulties

The percentages of valid and false positive and negative outcomes were calculated, the sensitivity and specificity indexes were computed, ANOVA analyses were performed, and a logistic regression analysis was performed to examine the prediction of spelling difficulties.

Percentages of valid and false positive and negative outcomes

Valid positive rate refers to the number of children who were predicted to have spelling difficulties that turned out to actually have spelling difficulties. False positive rate refers to the number of children who were predicted to have spelling difficulties that turned out to be typical spellers. Valid negative rate refers to the number of children who were predicted to become a typical speller and turned out to be typical spellers. False negative rate refers to the number of children that were predicted to become a typical speller, but turned out to have spelling difficulties. The percentages of valid and false positive and negative rates were computed for all precursors. These percentages are shown in Table 4. Phoneme spelling at the beginning of first grade and word spelling at the middle of first grade had the highest valid positive and negative rates, compared to the false positive and negative rates. This means that phoneme spelling at the beginning of first grade and word spelling at the middle of first grade best discriminated between children with and without spelling difficulties at the end of first grade.

Sensitivity and specificity indexes

The sensitivity index refers to the accuracy of a precursor to correctly identify children with spelling difficulties. The sensitivity index was computed for each precursor, by dividing the number of valid positives by the sum of the number of valid positives and false negatives. The specificity of a precursor refers to correctly identify children who do *not* have spelling difficulties. The specificity index was computed for each precursor by dividing the number of valid negatives by the sum of the valid negatives and false positives. The results are shown in Table 4. These results confirm the fact that phoneme spelling at the beginning of first grade and word spelling at the middle of first grade were the precursors that best identified children with spelling difficulties and children without spelling difficulties.

ANOVA analysis

All precursors were transformed into standardized z-scores, and thereafter, sum scores were computed for linguistic, phonological, orthographic, letter knowledge, memory, and nonverbal-reasoning skills. Word spelling at the middle of first grade was removed from these analyses for two reasons. The first reason was because of its strong correlation with letter knowledge. The second reason was because

Table 4 Overview of the Percentages Valid and False Positives and Negatives, Sensitivity and Specificity

Precursor	Valid Positive	False Positive	Valid Negative	False Negative	Sensitivity	Specificity
Linguistic skills						
Linearity of spoken language awareness	13.7	13.7	66.7	5.9	.70	.83
Articulation	6.9	19.0	56.9	17.2	.29	.75
Rapid naming Colors	11.3	15.1	60.4	13.2	.46	.80
Rapid naming Numbers	5.5	18.2	58.2	18.2	.23	.76
Rapid naming Pictures	10.7	14.3	62.5	12.5	.46	.81
Phonological skills						
Sound awareness and rhyming	11.8	19.6	60.8	7.8	.60	.76
Auditory synthesis I	9.8	15.7	61.7	9.8	.50	.80
Auditory synthesis II	12.0	20.0	48.0	20.0	.38	.71
Orthographic skills						
Awareness of written language	3.9	23.5	56.9	15.7	.20	.71
Letter-symbol distinction - score	7.7	19.2	55.8	17.3	.31	.74
Letter-symbol distinction - reaction time	8.5	14.9	61.7	14.9	.36	.81
Wordiness judgement	12.7	12.7	63.6	10.9	.54	.83
Memory skills						
Long-term memory	10.3	22.4	53.4	13.8	.43	.70
Short-term memory	5.2	10.3	65.5	19.0	.21	.86
Working memory	22.4	25.9	50.0	1.7	.93	.66
Nonverbal reasoning						
Nonverbal-deductive reasoning	8.6	20.7	55.2	15.5	.36	.73
Letter reading						
Score	11.5	13.5	61.5	13.5	.46	.82
Reaction time	8.3	16.7	60.4	14.6	.15	.78
Phoneme spelling						
Phoneme spelling	19.0	6.9	69.0	5.2	.79	.91
Word spelling						
Middle of first grade	18.5	7.4	74.1	0.0	1.00	.91

otherwise there would be circularity, because word spelling would predict word spelling. The 25% best and 25% poorest spellers at the end of first grade were selected. ANOVA analyses indicated that poor spellers at the end of first grade already had low scores on the precursor variables in kindergarten and vice versa. This is true for all precursors: linguistic skills, $F(1, 31) = 21.19$, $p < .001$; phonological skills, $F(1, 26) = 17.03$, $p < .001$; orthographic skills, $F(1, 30) = 8.31$, $p < .01$; memory skills, $F(1, 31) = 19.60$, $p < .001$; nonverbal-reasoning skills, $F(1, 31) = 4.22$, $p < .05$; and letter knowledge skills, $F(1, 31) = 40.94$, $p < .001$.

Logistic regression analysis

All sum scores were submitted into a stepwise logistic regression analysis to examine which combination of precursors discriminated best between children with spelling difficulties and children with a typical spelling development. The results showed that based on a model with only spelling level at the end of first grade, 50% of the children were classified into the correct category. However, when letter knowledge was included into the model, 85.7% of the children were classified correctly. Only letter knowledge had a unique discriminative value, B = -3.47, S.E. = 1.31, $p < .01$.

Discussion

This study was designed to investigate the main precursors of spelling difficulties for first grade children with SLI. A large number of precursors was used to predict spelling skill, namely, linguistic, phonological, orthographic, letter knowledge, memory skills, and nonverbal reasoning. Apart from these precursors, spelling level at an earlier point in time was taken into account as a precursor of spelling difficulties.

Calculation of the valid positive, valid negative, false positive, and false negative rates, showed that phoneme spelling at the beginning of first grade and word spelling at the middle of first grade best discriminated between typical spellers and poor spellers. The sensitivity index showed that on the basis of word spelling at the middle of first grade, children with spelling difficulties at the end of first grade could be identified 100% correctly. The specificity index showed that both phoneme spelling at the beginning of first grade and word spelling at the middle of first grade were rather accurate precursors to correctly identify children who do *not* have spelling difficulties (91% accuracy). The results of the logistic regression analysis showed that only letter knowledge has unique discriminative value.

To summarize, kindergarten precursors do have some discriminative value for the prediction of spelling difficulties. However, the only precursor that really has a unique discriminative value, is letter knowledge. Spelling difficulties can be best predicted by spelling level at an earlier point in time. We take these outcomes as a signature of autocatalytic processes regarding the acquisition of spelling. Without intervention, poor spellers at the middle of first grade generally remain poor spellers at the end of first grade, and good spellers at the middle of first grade remain good spellers at the end of first grade. These results are in line with Caravolas et al. (2001) and Lervåg and Hulme (2010), they also concluded that spelling was best predicted by spelling at an earlier point in time.

Implications for Future Research

The results of the present study indicated that the predictive value of kindergarten precursors, like among others, letter knowledge, phonological awareness, working memory, and rapid naming is negligible compared to the predictive value of spelling skill itself. Consequently, it is important that future research will focus on the development of spelling skills itself instead of focusing on precursors that have scarcely any predictive value.

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Appendix A. Letter-symbol distinction

Practice items

btg	znt
wzk	pkl
aei	ioa
#gh	^ht
nm?	tr=

Test items

mvn	m!n
lzp	l#p
fnh	fn?
bgm	?gm
dbk	d^k
oea	oe}
lv	^eu
ooee	oo~
blt	b+t
dws	d(s
vts	v~s
hjr	hj#
oeee	@ee
rwz	rw*
knz	kn?
hvk	h\k
aoe	=ae
oaau	oaa-
euu	$u
oij	<ij
ioe	%oe
ieoo	ie%
oau	>au
oou	*ou
wz	)z
pnw	pn>
iui	/ui
uuu	uu=
uuei	{ei
brt	+rt

Appendix B. Wordiness judgement

Practice items

zek		
	cccc	hon
dddd	rim	€
	re	xx

Test items

Pseudowords	Nonwords	String with symbols
nem	mvn	m!n
roo	hjr	hj#
vot	vts	v~s
lop	lzp	l#p
duk	dbk	d^k
mas	oea	oe}
nit	knz	kn?
kal	blt	b+t
huk	hvk	h\k
zil	aoe	=ae
zeun	oaau	oaa-
sak	euu	$u
fij	oij	<ij
woe	ioe	%oe
muid	ieoo	ie%
hauk	oau	>au
aag	oou	*ou
vour	wz	)z
wui	pnw	pn>
beg	iui	/ui
haap	uuu	uu=
len	uuei	{ei
mar	brt	+rt
weig	bgm	gm?
jaf	fnh	fn?
tief	dws	d(s
foo	oeee	@ee
beem	ooee	oo~
luus	rwz	rw*
biek	lv	^eu

Appendix C. Letter reading

Practice items

1 2 3 4 5

Test items

a b d e f g h i j k l m n o p r s t u v w z
eu ou ui oe au ei ij ie
oo ee uu aa
ɑ ɑɑ

Appendix D. Phoneme spelling

Test items

b d f g h j k l m n p r s t v w z
a e i o u
aa ee oo uu
eu ui oe ie au ou ei ij

Write down the ...	of ...	
i	ik	[I]
k	kaas	[cheese]
m	mus	[sparrow]
aa	aap	[monkey]
n	nek	[neck]
r	rook	[vapor]
oo	oom	[uncle]
s	sok	[sock]
o	om	[around]
v	vis	[fish]
p	pak	[package]
e	en	[and]
t	teen	[toe]
ee	een	[one]
eu	reus	[giant]
b	boos	[angry]
ui	uil	[owl]
g	gaap	[yawn]
oe	koe	[cow]
d	doek	[cloth]
a	appel	[apple]
f	fiets	[bicycle]
l	lamp	[lamp]
h	huis	[house]
u	hut	[shed]
j	jas	[coat]
uu	muur	[wall]
z	zaag	[saw]
ie	knie	[knee]
w	wolf	[wolf]
au	auto	[car]
ou	hout	[wood]
ij	ijs	[ice]
ei	geit	[goat]

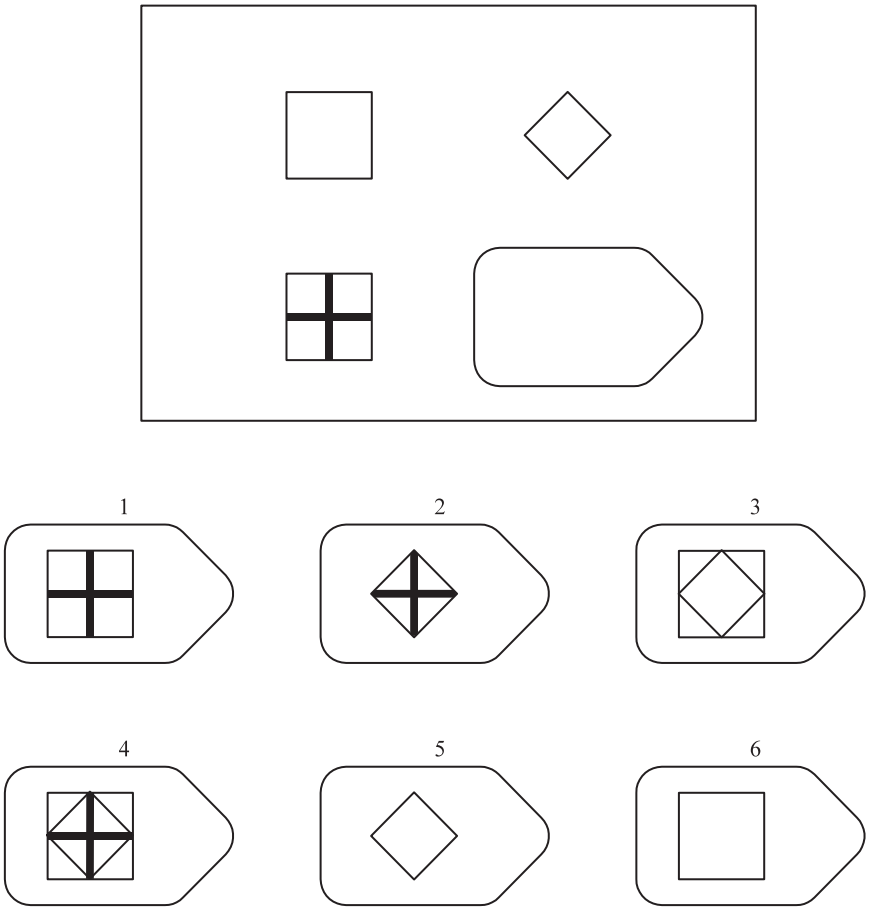
Appendix E. Long-term memory

Test items

peer *[pear]*
koe *[cow]*
bril *[glasses]*
tulp *[tulip]*
duim *[thumb]*
stoel *[chair]*
kers *[cherry]*
leeuw *[lion]*
hoed *[hat]*
roos *[rose]*
neus *[nose]*
bed *[bed]*

Appendix F. Nonverbal reasoning

Raven's Progressive Matrices -
Standard Progressive Matrices Sample Item



Simulated item similar to those in the *Raven's Progressive Matrices - Standard Progressive Matrices.*

Part II

Acquisition

Chapter 3

Characteristics of early spelling of children with Specific Language Impairment

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This chapter has been published as:
Cordewener, K. A. H., Bosman, A. M. T., & Verhoeven, L. (2012).
Characteristics of early spelling of children with Specific Language Impairment.
Journal of Communication Disorders, 45, 212-222.

Abstract

The present study investigated active grapheme knowledge and early spelling of 59 first grade children with specific language impairment (SLI). *Speed*, *nature*, and *knowledge transfer* of spelling acquisition were taken into account. Four orthographic characteristics that influence early spelling, namely, 'Type of grapheme', 'Grapheme position', 'Number of graphemes', and 'Word structure' were examined at the middle and the end of first grade. At the beginning of first grade when children were between 71 and 97 months, they performed well below national norms on assessment of active grapheme knowledge. The delay in word spelling persisted, but decreased between the middle and the end of first grade. Despite this delay, the findings suggest that characteristics of early spelling for children with SLI are rather similar to those of children with typical language development. For example, children with SLI represented more graphemes at the end of first grade than at the middle of first grade, found it easier to represent the initial grapheme in words than the final or medial grapheme (Grapheme position), were more successful spelling shorter than longer words (Number of graphemes), and spelled words with simple structures (CVC) more accurately than those with complex structures (CVCC and CCVC; Word structure). Finally, participants demonstrated that they can use known graphemes to spell words, but the transfer between active grapheme knowledge and word spelling was not always stable.

Characteristics of Early Spelling of Children with Specific Language Impairment

Specific Language Impairment (SLI) refers to a failure of typical language development despite the absence of a mental or physical handicap, hearing impairment, emotional disorder or environmental deprivation (Bishop, 1992; Leonard, 1998). Problems in language development are strongly associated with problems in the acquisition of literacy (Catts, 1993; Catts, Fey, Zhang, & Tomblin, 1999). Although research on spelling and spelling instruction in children with SLI is scarce, it is known that they are at risk for developing spelling delays (Lewis, Freebairn, & Taylor, 2000; Nathan, Stackhouse, Goulandris, & Snowling, 2004; Nauclér, 2004; Snowling, Bishop, & Stothard, 2000) and spelling problems (Kamhi & Catts, 1986; Kamhi, Catts, Mauer, Apel, & Gentry, 1988).

Snowling et al. (2000) showed that the reading and spelling difficulties of a group of children with SLI increased between the ages of 8 and 15, albeit spelling difficulties increased less than reading difficulties. It is unknown, however, whether spelling delays emerge at the start of formal reading and spelling instruction and whether this delay increases over time in first grade. Another more qualitative aspect pertains to the nature of spelling difficulties. That is, to what extent are spelling problems of children with SLI different from those of children with typical language development? Neither of these issues has been addressed before.

Phonology and Spelling

Phonology is one aspect of spelling development that has been studied extensively because it plays a fundamental role in spelling and reading (e.g., Ashby, 2010; Diependaele, Ziegler, Grainger, 2010; Frost, 1998; Van Orden, Pennington, & Stone, 1990). It affects spelling and spelling acquisition in both typically developing children (Bosman & Van Orden, 1997; Caravolas, Volín, & Hulme, 2005; Cataldo & Ellis, 1988; Plaza & Cohen, 2003, 2004, 2006) and children with language impairments (Cromer, 1980; Nauclér, 2004). Although spelling performance is not only influenced by phonological skills, but also by syntactic awareness and naming-speed processes (Plaza & Cohen, 2003), phonology appears to have the strongest influence on spelling (Caravolas et al., 2005; Cataldo & Ellis, 1988; Plaza & Cohen, 2003, 2004, 2006). Nauclér (2004), for example, showed that spelling errors of first-grade children with SLI mainly consist of omissions and substitutions of graphemes (mostly context independent), unlike spelling errors of typically developing children. It is clear that children with SLI are struggling with the phonological structure of words.

Spelling is not only difficult for children with SLI, it is also generally more difficult to acquire than reading (see for a detailed discussion Bosman & Van Orden, 1997; Stone, Vanhoy, & Van Orden, 1997). Spelling is more difficult than reading, because in most alphabetic languages, including Dutch and English, grapheme-to-phoneme consistency is higher than phoneme-to-grapheme consistency. In other words, there are more possible spellings for a particular word than possible readings. For example, the phoneme [i:] can be spelled as Y in *Entry*, EY in *Key*, EE in *Deep*, EA in *Leaf*, and IE in *Chief*, whereas the reading of each of the graphemes is relatively unambiguous.

An important finding related to the phonology of spelling is that the majority of spellers commit errors that are phonetically acceptable rather than unacceptable. Nauclér (2004), however, found that the majority (two third) of the spelling errors of children with SLI were phonetically unacceptable. A phonetically acceptable spelling error can be pronounced identically to the intended word when grapheme-to-phoneme correspondence rules are used (Bosman & Van Orden, 1997). An example of a phonetically acceptable error is CHEEP for the word 'cheap', whereas CHEAM is phonetically unacceptable.

Phonology is not a factor in the current study because in the Dutch education system children start with words that have consistent grapheme-phoneme relationships in their spelling. In the current study, the words used obey the same prototypical phoneme-grapheme relationships. This means that a phonetically acceptable spelling is a correct spelling; therefore, there is not a distinction to be made between phonetically acceptable and unacceptable spellings. Furthermore, spelling problems are not just related to the phonological aspects of words. Orthographic characteristics also affect spelling and spelling acquisition.

Orthography and Spelling

To our knowledge, there are no studies that focused exclusively on orthographic characteristics regarding early spelling of children with SLI. Previous research on typically developing children identified word characteristics that affect the difficulty of spelling, such as, word frequency, consistency of the phoneme-grapheme relationship, orthographic restriction of a language, type of grapheme, grapheme position within a word, number of graphemes, and word structure. For example, words that are used more frequently in a language are spelled more accurately than low-frequency words (Kreiner, 1992), and words with more consistent phoneme-grapheme relationships are spelled more accurately than words with inconsistent phoneme-grapheme relationships (Fischer, Shankweiler, & Liberman, 1985). Furthermore, typically developing spellers who are learning to spell in a language with orthographic restriction that imposes spelling principles and rules (Nunn, 1998), focus first on phonological information while they learn

to rely on orthographic information over time (Varnhagen, Boechler, & Steffler, 1999).

In the current study, we are interested in understanding the very early beginnings of spelling development in children with SLI. As such, we chose to use words that have high frequency in Dutch, have consistent phoneme-to-grapheme relationships, and are not affected by orthographic rules. The four characteristics that are the focus of the present study are: *Type of grapheme*, *Grapheme position* within a word, *Number of graphemes*, and *Word structure*.

With regard to *Type of grapheme*, findings from studies in different languages indicated that young children made more errors in writing vowels than in consonants (Stage & Wagner, 1992; Treiman, Berch, & Weatherston, 1993; Wimmer & Landerl, 1997). A possible explanation for this result is that vowels are more phonetically related to each other than consonants; they sound more similar to each other than consonants (van den Berg, 1972). This could make it more difficult for children to choose the correct vowel in spelling a word. Note, however, that in the Dutch language, there are also consonants that are phonetically related, and consequently are confusing for children, like the /v/ and /f/ and the /s/ and /z/.

With regard to *Grapheme position,* it was found that within a CVC (consonant-vowel-consonant) word, spelling of the onset is easiest, followed by spelling of the coda, which in turn is easier than the spelling of the nucleus (i.e., the V in CVC words; de Graaff, Hasselman, Bosman, & Verhoeven, 2008; Treiman et al., 1993). Moreover, previous research has also indicated that children in first grade have difficulties in spelling a consonant following a vowel in CVCC words (Treiman, Zukowski, & Richmond-Welty, 1995).

Finally, with regard to *Number of graphemes*, findings from one Dutch study (Jansen & Luurtsema, 1986) and two English studies (Treiman, 1993; Wilson & Bock, 1985) indicated that writing longer words resulted in more spelling errors than writing shorter words. This conclusion seems obvious, because when a word contains more phonemes, there are more opportunities to make a spelling error.

The characteristic *Word structure* refers to the combination of vowels (V) and consonants (C). For instance, the word structure of DUCK is CVCC. The structure of a word is related to the three characteristics described above: *Type of grapheme*, *Grapheme position*, and *Number of graphemes*. Two Dutch studies showed that segmentation of complex words was more difficult than segmentation of less complex words for children with learning disabilities (Kerstholt, van Bon, & Schreuder, 1994, 1997). Spelling of CVC words was easier than of CCVC words, CCVC words were easier than CVCC words, and CVCC words were easier than CCVCC words. The influence of *Word structure* was also investigated in typically developing children. Treiman and Weatherston (1992) showed that word structure influences children's ability to isolate initial consonants. It was more difficult for

children to isolate the initial consonant when this consonant was part of a consonant cluster than when it was not. This is in accordance with the results of Schreuder and van Bon (1989). They showed that consonant clusters were not only difficult to segment, but that consonant clusters made it more difficult to segment other phonemes in a word. In sum, the present study investigated whether the spelling of children with SLI is similarly influenced by the word characteristics: type of grapheme, grapheme position, number of graphemes, and word structure.

Knowledge Transfer in Spelling

In addition to these four word characteristics, the present study was designed to examine *knowledge transfer* of spelling a grapheme in isolation and spelling the same grapheme in a word. Grapheme knowledge is a main requisite for the development of spelling skills (Caravolas, Hulme, & Snowling, 2001; Furnes & Samuelsson, 2010; Lervåg & Hulme, 2010; Muter, Hulme, Snowling, & Taylor, 1998; Ouellette & Sénéchal, 2008), because spelling in an alphabetical language requires the knowledge of graphemes that represent the phonemes of the language[1] (Nunn, 1998). However, when a child is able to write down the grapheme 'b', he or she may not necessarily use the 'b' in writing the word 'book'. Therefore, we also investigated the transfer from active grapheme knowledge to the spelling of a word. It is important to know whether or not children make this transfer from being able to write down an isolated grapheme to using this grapheme in the spelling of a word, because the educational system assumes that children make this transfer. Two difficulties may arise with respect to this transfer. One, children have to be able to perceive the phoneme correctly. Correct perception may be difficult, because the pronunciation of an isolated phoneme sounds different from its pronunciation in the context of a word. Two, children have to be able to insert the grapheme that corresponds with the phoneme in the proper place in the sequence.

Present Study

The children who participated in the present study all attended Dutch schools. Dutch orthography is more consistent than English, both from phoneme to grapheme and from grapheme to phoneme (Bosman, Vonk, & van Zwam, 2006; Patel Snowling, & de Jong, 2004). However, in Dutch, no perfect one-to-one correspondence between phonemes and graphemes exists either (Nunn, 1998). Despite the differences in orthographic systems, there are only small differences in learning a consistent or an inconsistent orthography (Caravolas et al., 2005;

1 For proper spelling, one needs to know all graphemes of a language. However, sometimes young children are able to spell a word without being able to spell or name the separate graphemes of that word. In these cases, children know the shape of the word or the movements they have to make. This is often the case in writing their own name.

Furnes & Samuelsson, 2009, 2010; Patel et al., 2004). For instance, phoneme awareness appears to be equally important for the acquisition of spelling in consistent and inconsistent orthographies (Caravolas et al., 2005; Furnes & Samuelsson, 2009, 2010). We therefore hypothesize that the findings and interpretations of the present study are also applicable for other languages, like for example English.

The goal of this paper is threefold. The first goal refers to the *speed* of spelling acquisition. Does spelling acquisition of children with SLI show a delay in first grade and does this delay increase, decrease, or remain stable? Grapheme knowledge was measured at the beginning[2] and the end of first grade. Spelling level was measured at the middle and the end of first grade to examine whether the delay in spelling skills stays stable during first grade.

The second goal concerns the *nature* of spelling acquisition. The main question is: Do orthographic characteristics that have been known to affect spelling skills in typically developing children also affect those of children with SLI? It was also investigated whether the influence of the different orthographic word characteristics was stable over time during first grade.

The third goal refers to *knowledge transfer*. Is knowledge of the spelling of a grapheme sufficient to spell that particular grapheme in a word? Spelling isolated graphemes will be compared with the spelling of words in which this grapheme appears. To be able to answer these questions, active grapheme spelling and word spelling abilities of first grade children with SLI were assessed at three moments of measurement.

Method

Participants

This study was conducted with children who attended special-education schools in the Netherlands. Three schools with ten first-grade classes were invited to participate in order to obtain a sufficient number of children. Deaf and hearing-impaired children were excluded from the study. Only children who participated at all three moments of measurement were included. Due to illness or absence, 19 children were excluded.[3] The final sample consisted of 59 children (21 girls,

2 Grapheme knowledge could not be measured later during first grade, because after five months in first grade, children can name all graphemes, and after eight months they can also write all graphemes (Struiksma, van der Leij, & Vieijra, 2009). After the beginning of first grade, we should not be able to determine the spelling delay, because of a ceiling effect.

3 The scores of the group of children that dropped out of the study did not differ significantly from the scores of the remaining group on the grapheme and word spelling tasks.

38 boys) between the ages of 71 and 97 months at the beginning of first grade (*M* = 82;2, *SD* = 5;1).

In the Netherlands, almost all children with SLI attend a special-education school. Each child is re-evaluated every two years by a team of experts to determine whether or not the child still fits the criteria for SLI (van Weerdenburg, 2006). At these schools, children receive extra instruction and the schools have smaller classes than in mainstream education. Literacy education starts in kindergarten with phonological-awareness and letter-knowledge training. Formal reading and spelling instruction starts in Grade 1. Teachers make use of a range of methods for literacy education. All participating schools made use of letter-sound gestures to stimulate the children's letter knowledge. Children learn to make a gesture with their hand(s), while simultaneously pronouncing the sound of the letter. The gesture is mostly connected to both the sound and the shape of the letter. Because of the letter-sound gestures, the children experience auditory, visual, and kinesthetic support during the process of learning the letters. It is assumed that the involvement of all modalities enhances the acquisition of letter knowledge. The three participating schools made use of a variety of letter-sound gestures. One of the letter-sound gesture systems is developed by Borel-Maissony and used in the reading and spelling methodology 'Zo leer je kinderen lezen en spellen' [How to teach children reading and spelling] (Bosman, 2007; Schraven, 2004).

Materials

Grapheme spelling

Active knowledge of phoneme-grapheme relationships was measured by a grapheme-spelling test. The child had to write a grapheme named by the experimenter. The experimenter named the grapheme and a word that contained this grapheme (in either the initial position, or, in case of vowels or digraphs in the middle position). The graphemes used in this test were: b, d, f, g, h, j, k, l, m, n, p, r, s, t, v, w, z, a, e, i, o, u, aa, ee, oo, uu, oe, eu, ui, ou, au, ie, ei, and ij. The score equaled the number of correctly written graphemes. The lowest possible score was zero and the highest possible score was 34.

Word spelling

This skill was measured by a standardized spelling test 'Schaal Vorderingen in Spellingvaardigheid 1 Dictee 2' (van den Bosch, Gillijns, Krom, & Moelands, 1991 [Scale Progression in Spelling Abilities 1 Dictation 2]). The child had to write 22 monosyllabic words with consistent phoneme-to-graphemes relations. This means that when children know the phoneme-grapheme correspondences, no confusion can exist about which grapheme has to be used in the word. Phonology is thus involved in the correct application of phoneme-grapheme correspondences. Thus,

proper segmentation most likely leads to the correct spelling of a word. The Appendix presents the words and the corresponding word structures used in this test. The monosyllabic words had a vowel-consonant (VC), CVC, CCV, CVCC, or CCVC structure. For each word, the number of correctly written graphemes was computed and divided by the number of graphemes within that word. The lowest possible score was zero and the highest possible score was 22.

To measure the word characteristic *Type of grapheme*, the correctness of each vowel and each consonant within a word was assessed. The 22 words consisted of 78 graphemes in total: 22 vowels and 56 consonants. To measure *Grapheme position*, all 78 graphemes were divided into one of three positions: onset, nucleus or coda. In CCVC-words, the two C's are considered the onset, and in CVCC-words the C's are considered the coda. To measure *Number of graphemes*, all 78 graphemes were divided into two categories: graphemes from words consisting of 2 or 3 graphemes or 4 graphemes. To measure *Word structure*, the words were divided into three categories: CVC, CVCC or CCVC words. The two words with a VC and CCV structure were excluded from this analysis, because they do not fit any of the three structures.

Procedure

Letters were sent to the school administration inviting them to participate in the study. Reply forms were attached with the letter. A few weeks later, the schools were also contacted by phone.

All children were tested after the summer holiday, at the beginning, middle, and end of first grade, that is, after three, five, and nine months of formal spelling instruction, respectively. Grapheme spelling was tested at the beginning and the end of first grade and word spelling was tested at the middle and the end of first grade. For grapheme spelling at the beginning of first grade, each child was tested individually in a separate quiet room in school. The other tests were administered in class. The children wrote the graphemes or the words down to dictation. The first author, with the help of four research assistants tested all children.

Results

Speed of Spelling Acquisition

Delay in Grapheme knowledge and Word spelling

Delay in Grapheme knowledge

According to national Dutch norms, the active-grapheme knowledge of typically developing children is between 20 and 23 graphemes out of 34 graphemes at the beginning of first grade (three months after summer holiday; Struiksma et al., 2009). The average active grapheme knowledge of children with SLI was 17

graphemes. The mean scores on grapheme knowledge and word spelling are presented in Table 1.

Table 1 Mean Scores on the Different Tests

	N	M (SD)
Grapheme Spelling		
Beginning of first grade	59	16.59 (6.43)
End of first grade	59	28.71 (5.78)
Word Spelling		
Middle of first grade	59	12.72 (6.53)
End of first grade	59	16.81 (5.23)

Delay in Word spelling

Because the word-spelling test used in the present study is a standardized test, all scores were transformed into norm scores to compare the scores of children with SLI with the scores of children with typical language development. We used the standardized CITO-norms (van Kuyk, 1996). This system distinguishes five levels; Level A refers to the 25% best scoring children. Level B refers to the next 25% best scoring; thus still above the national average. Level C (25%) is the group that scores just below the national average. Level D (15%) performs poorly to moderately. Level E refers to the 10% lowest scoring children. Table 2 presents the percentages of children with SLI at each level at the middle and the end of first grade. Both at the middle and the end of first grade, 64.4% of the children with SLI have scores that correspond with the lowest scoring level. Moreover, at the middle of first grade 94.4% of the children had scores below the national average, and at the end of first grade this was 88.1% of the children.

Development of the delay in Word spelling

Table 2 presents the percentages of children with SLI at each of the five levels at the middle and the end of first grade. The delay of the children with SLI decreased significantly between the middle and the end of first grade, χ^2 (4) = 14.58, $p < .01$.

Nature of Spelling Acquisition

Orthographic characteristics that influence the difficulty of spelling

Analyses

To prepare the data for analysis, item means for each condition were computed as well as subject means. Next, the results of a GLM-procedure on each of the word characteristics with moment of measurement (middle vs. end of first grade) as

Table 2 Percentage of Children at the Different Levels

Level	Typical development (%)	SLI (%)	
		Middle of first grade	End of first grade
A	25	3.4	5.1
B	25	1.7	6.8
C	25	8.5	0.0
D	15	22.0	23.7
E	10	64.4	64.4

independent factor were presented. The four grapheme characteristics are: Type of grapheme (vowel vs. consonant), Grapheme position (onset vs. nucleus vs. coda), Number of graphemes (2 or 3 vs. 4), and Word structure (CVC vs. CVCC vs. CCVC). In the item as well as in the subject analyses, Time was treated as a within-subjects variable. In the item analyses, grapheme and word characteristics were treated as between-subjects variable, whereas in the subject analyses, grapheme and word characteristics were treated as within-subjects variable. The results of the item analyses are presented as F_i and the results of the subject analyses are presented as F_s. If Mauchly's test indicated that the assumption of sphericity was violated for main or interaction effects, the Greenhouse-Geisser correction was used. The mean scores for the two moments of measurement are presented in Table 3.[4]

Orthographic characteristics

Type of grapheme. The main effect of Type of grapheme did not reach a significant level, revealing that spelling consonants was equally easy (or difficult) as spelling vowels, $F_i(1, 76) = .68$, $p = .41$, *partial* $\eta^2 = .01$, and $F_s(1, 58) = .70$, $p = .41$, *partial* $\eta^2 = .01$. The main effect of Time was significant, $F_i(1, 76) = 188.79$, $p < .0001$, *partial* $\eta^2 = .71$, and $F_s(1, 58) = 66.20$, $p < .0001$, *partial* $\eta^2 = .53$, revealing that children had higher scores on writing graphemes at the end of first grade than at the middle of first grade. The interaction effect between Time and Type of grapheme did not reach a significant level, $F_i(1, 76) = 1.62$, $p = .21$, *partial* $\eta^2 = .02$, and $F_s(1, 58) = 3.48$, $p = .07$, *partial* $\eta^2 = .06$.

Grapheme position. The main effect of Grapheme position did not reach a significant level by items, $F_i(1, 75) = 1.94$, $p = .15$, *partial* $\eta^2 = .05$, but it was significant by subjects,

4 Note that because the variables could not be orthogonally manipulated, it was impossible to test for interaction effects among word characteristics on children's performance. For instance, Grapheme position is associated with Type of grapheme. There is no equal division of consonants and vowels in coda position. Consonants appear more often in onset or coda position than in nucleus position, and for vowels this is vice versa.

Table 3 Mean Scores at the Two Moments of Measurement (Item Analyses)

		Time 1	Time 2
	N	M (SD)	M (SD)
Type of grapheme			
Vowel	22	.54 (.12)	.72 (.09)
Consonant	56	.58 (.16)	.73 (.10)
Grapheme position			
Onset	27	.61 (.18)	.75 (.10)
Nucleus	21	.55 (.11)	.72 (.10)
Coda	30	.54 (.13)	.71 (.10)
Number of graphemes			
2-3	26	.66 (.15)	.79 (.08)
4	52	.52 (.12)	.69 (.09)
*Word structure**			
CVC	7	.50 (.14)	.61 (.10)
CVCC	8	.23 (.05)	.40 (.07)
CCVC	5	.18 (.05)	.43 (.06)

* Note that two words of the word spelling test had another structure (i.e., VC and CCV) and because of the otherwise unequal division, these words were excluded from the analyses for word structure.

$F_s(2, 116) = 8.30$, $p < .0001$, *partial* $\eta^2 = .13$. Subsequent post-hoc analyses revealed that it was easier for children to write onset graphemes than to write nucleus or coda graphemes (p's < .01; Bonferroni corrected). The main effect of Time was significant, $F_i(1, 75) = 208.20$, $p < .0001$, *partial* $\eta^2 = .74$, and $F_s(1, 58) = 71.05$, $p < .0001$, *partial* $\eta^2 = .55$, revealing that children had higher scores on writing graphemes at the end of first grade than at the middle of first grade. The interaction effect between Time and Grapheme position did not reach a significant level, $F_i(2, 75) = .54$, $p = .54$, *partial* $\eta^2 = .01$, and $F_s(1.88, 109.05) = 1.15$, $p = .32$, *partial* $\eta^2 = .02$.

Number of graphemes. The main effect of Number of graphemes was significant, $F_i(1, 76) = 22.90$, $p < .0001$, *partial* $\eta^2 = .23$, and $F_s(1, 58) = 71.79$, $p < .0001$, *partial* $\eta^2 = .55$, revealing that spelling words with two or three graphemes was easier than spelling words with four graphemes (p's < .0001; Bonferroni corrected). The main effect of Time was significant, $F_i(1, 76) = 178.51$, $p < .0001$, *partial* $\eta^2 = .70$, and $F_s(1, 58) = 66.53$, $p < .0001$, *partial* $\eta^2 = .53$, revealing that children had higher scores on writing graphemes at the end of first grade than at the middle of first grade.

The interaction effect between Number of graphemes and Time was significant by items, $F_i(1, 76) = 4.76$, $p < .05$, *partial* $\eta^2 = .06$, but not by subjects, $F_s(1, 58) = 2.30$, $p = .14$, *partial* $\eta^2 = .04$. Subsequent ANOVA by items revealed that the increase in scores between the middle and the end of first grade was larger for words

containing four graphemes than for words containing two or three graphemes.

Word structure. The main effect of Word structure was significant, $F_i(2, 17) = 19.47$, $p < .0001$, *partial* $\eta^2 = .70$, and $F_s(2, 116) = 54.53$, $p < .0001$, *partial* $\eta^2 = .49$, revealing that spelling CVC words was easier for children than spelling CVCC and CCVC words (p's <.0001; Bonferroni corrected). The main effect of Time was significant, $F_i(1, 17) = 152.06$, $p < .0001$, *partial* $\eta^2 = .90$, and $F_s(1, 58) = 64.44$, $p < .0001$, *partial* $\eta^2 = .53$, revealing that children had higher scores on spelling words at the end of first grade than at the middle of first grade.

The interaction effect between Word structure and Time was significant, $F_i(2, 17) = 6.96$, $p < .01$, *partial* $\eta^2 = .45$, and $F_s(2, 116) = 6.20$, $p < .001$, *partial* $\eta^2 = .10$. Subsequent ANOVA, by items, revealed that the increase in scores between the middle and the end of first grade was larger for CCVC words than for CVC words ($p < .01$; Bonferroni corrected). By subjects, the increase in scores between the middle and the end of first grade was larger for CCVC words than for CVC and CVCC words (p's < .01; Bonferroni corrected).

Knowledge Transfer in Spelling

There was a significant relationship between grapheme spelling at the beginning of first grade and word spelling at the middle of first grade, $r = .77$, $p < .0001$. Grapheme spelling and word spelling were also significantly correlated at the end of first grade, $r = .71$, $p < .0001$.

To test whether grapheme knowledge is transferred to word spelling, the data were coded in the following way: 0 for not knowing the grapheme and not using the grapheme in spelling a word; 1 for knowing the grapheme and not using the grapheme in spelling a word; 2 for not knowing the grapheme and using the grapheme in spelling a word; and 3 for both knowing the grapheme and using the grapheme in spelling a word. Paired sample t tests were performed to compare the number of the values 0 versus 2 and 1 versus 3. The number of values was converted into percentages.

The mean percentages and standard deviations for the four different situations are presented in Table 4. The results of the paired sample t tests indicated that at the end of first grade, when children know a particular grapheme, they more often use that grapheme in spelling a word ($M = 70.47$, $SD = 26.73$), than not using that grapheme in spelling a word ($M = 16.71$, $SD = 16.16$), $t(59) = -10.06$, $p < .0001$. When children do not know a particular grapheme, they consequently more often do not use that grapheme in spelling a word ($M = 7.89$, $SD = 12.32$), than they do use that grapheme in spelling a word ($M = 4.93$, $SD = 6.28$), $t(58) = 2.09$, $p < .05$. As shown in Table 4, more than 20% of the scores are inconsistent. Thus, knowledge transfer from grapheme spelling to word spelling or from word spelling to grapheme spelling is still unstable at the end of Grade 1.

Table 4 Mean Percentages for Spelling Graphemes in Isolation and in Words

Code	Grapheme	Word	Stability	%	
				M	*SD*
0	no	no	stable	7.9	12.3
1	yes	no	instable	16.7	16.2
2	no	yes	instable	4.9	6.3
3	yes	yes	stable	70.5	26.7

Discussion

The present study was conducted to investigate early spelling of first grade children with SLI. The present study examined the *speed*, *nature*, and *knowledge transfer* of spelling acquisition.

The first aim was to investigate the *speed* of spelling acquisition, and in particular whether children with SLI indeed have delay in grapheme knowledge and early spelling and whether this delay remains stable during first grade. The results indicated that children with SLI have both a delay in grapheme spelling at the beginning of first grade, and in word spelling at the middle and the end of first grade. The results also indicated that this delay in word spelling decreases between the middle and the end of first grade. Some children catch up during first grade. Thus, a delay exists between early spelling of children with SLI and typically developing children, which is in accordance with findings from previous research (Lewis et al., 2000; Nathan et al., 2004; Nauclér, 2004; van Weerdenburg, Verhoeven, Bosman, & van Balkom, 2011). Unlike the findings of Snowling et al. (2000), in the present study the delay decreased during first grade.

The second aim was to examine the *nature* of spelling acquisition. The first question was which orthographic characteristics influence early spelling of children with SLI at the middle and the end of first grade. The results of the present study indicated that the characteristics *Grapheme position*, *Number of graphemes*, and *Word structure* influenced the difficulty of spelling a word for children with SLI almost similarly as that of typically developing children. With respect to all word characteristics, the scores at the end of first grade were higher than those at the middle of first grade.

With regard to *Grapheme position,* previous research indicated that for typically developing first grade children, spelling the onset is easiest, followed by the coda, and the most difficult part is the spelling of the nucleus (in CVC words; Treiman et al., 1993). The present study indicated that children with SLI found spelling of the onset easier than of the nucleus or coda. In contrast with the study of Treiman et

al. (1993), no difference was found between spelling of the nucleus and coda. This may be due to the fact that the children with SLI from the present study performed at a lower level; a level that was similar to that of the kindergartners from the study of Stage and Wagner (1992). The children in that study also found the onset easiest, but showed no difference between the spelling of the nucleus and the coda. These findings suggest that a difference emerges between the accuracy of spelling the nucleus and coda when spelling level increases. It appears that young spellers mainly focus on the onset grapheme, because their scores on the nucleus and coda graphemes were equally low, as in a floor effect.

There is also another explanation for the fact that the present study indicated no difference between the spelling of nucleus and coda graphemes. In the present study, onset 1 and onset 2 graphemes were combined in a sum score (e.g., C_1C_2VC), and the same was done for coda 1 and coda 2 graphemes (e.g., CVC_1C_2). It is perhaps harder for children to correctly write down both coda graphemes in comparison with the nucleus grapheme. Previous research also indicated the difficulty of segmenting a consonant cluster (Schreuder & van Bon, 1989; Treiman & Weatherston, 1992). We combined the graphemes because of the otherwise unequal division of the different grapheme positions. A study by van Bon and Duighuisen (1995) confirms this explanation. They also found that spelling onset consonant clusters (i.e., first CC in *CC*V(C) and *CC*VCC words) was easier than spelling coda clusters (i.e., final CC in CV*CC* and CCV*CC* words). The consonant next to the vowel was more often deleted in coda position than in onset position. Perhaps the coda consonant next to the vowel was embedded in the rime sound and the onset consonant next to the vowel had a more distinct position. Yet another explanation is the increased memory load for the final consonant next to the vowel (van Bon & Duighuisen, 1995).

With regard to *Number of graphemes*, previous research with typically developing children indicated that writing longer words resulted in more spelling errors than writing shorter words. This was exactly the same for children with SLI. Writing longer words means a higher memory load for children than writing shorter words. Children have to keep more graphemes in their memory, and they are, therefore, more likely to make an error. Children with SLI often have a delay in their verbal-sequential memory (Wentink, Hoogenboom, & Cox, 2009). This means that it is difficult for them to remember and retrieve graphemes that are presented in a particular order. In the case of spelling, children have to remember graphemes and retrieve them in a particular order. In the spelling of longer words, the memory load is higher and there is an increased chance for making an error.

Regarding the characteristic *Word structure*, the results of the present study for children with SLI are consistent with the results of previous studies with children with learning disabilities (Kerstholt et al., 1994, 1997) and children without

learning disabilities (Schreuder & van Bon, 1989; Treiman & Weatherston, 1992). That is, CVC words were easier to spell than CVCC and CCVC words. This is quite obvious, because CVC words are shorter than CVCC and CCVC words. Spelling shorter words is easier than spelling longer words (Treiman, 1993; Wilson & Bock, 1985). Moreover, consonant clusters (i.e., in CV*CC* and *CC*VC words) are more difficult to segment than single consonants (i.e., in CVC words; Schreuder & van Bon, 1989; Treiman & Weatherston, 1992). In contrast to previous studies, children in the present study find CCVC words not easier than CVCC words. This is partly consistent with results of early spellers from van Bon and Duighuisen (1995). They found no differences in early spellers between solitary onset and coda consonants (i.e., in *CVC*, *C*VCC, and CCV*C* words); the spelling of both types was at ceiling. However, they found that spelling onset consonant clusters was easier than spelling coda clusters (i.e., in *CC*V(C), CV*CC*, and *CCVCC* words).

With regard to *Type of grapheme*, previous research indicated that typically developing children made more errors in writing vowels than in writing consonants. The children with SLI in this study did not show this difference, no difference emerged between writing vowels or consonants. There are two possible explanations for this finding.

One explanation is that, in the words used in the present study, many consonants occur in consonant clusters (e.g., 'bee*st*'[beast], 'ru*ps*' [caterpillar], '*br*ug' [bridge], and '*bl*oem' [flower]). It is more difficult to write both consonants correctly when they occur in a consonant cluster.

The explanation why it is easier for typically developing children to write consonants than to write vowels, is that vowels are more phonetically related than consonants (van den Berg, 1972). As said in the introduction, not only may Dutch consonants provide difficulties for spelling, the vowels in the words used in this test do not yet provide severe difficulties, because they are used in phoneme-grapheme consistent words. This may be another reason why writing consonants was as difficult or easy as writing vowels for children with SLI. It appears that the difference with previous studies is caused by the consonant (clusters) used in the present study, and most likely not by the fact that the children in the present study are suffering from SLI. To conclude, the characteristics that influence early spelling of children with SLI appear to be quite similar to those of typically developing children.

The influence of the characteristics *Type of grapheme* and *Grapheme position* was stable over time, whereas the characteristics *Number of graphemes* and *Word structure* resulted in an increase in spelling performance over time. With regard to *Number of graphemes*, the increase in scores between the middle and the end of first grade was larger for words containing four graphemes than for words containing two or three graphemes. Regarding the characteristic *Word structure,* the increase in

scores was larger for CCVC words than for CVC (and, by subjects CVCC) words. Between the middle and the end of first grade, children with SLI showed a larger growth in the spelling of difficult words than in the spelling of easier words.

The third question concerning the *knowledge transfer* of spelling acquisition was whether there is a difference in writing a single grapheme and writing that grapheme in a word. The results indicated that when children know a particular grapheme, they most likely also use that grapheme in the spelling of a word at the end of first grade. Thus, children make a transfer between active grapheme knowledge and word spelling, despite the fact that a phoneme sounds different when it is pronounced separately than when it is pronounced in the context of a word. It turned out that children with SLI are generally able to use the correct phoneme in the context of a word.

Note that the results also indicated that 20% of the scores are inconsistent, revealing that children know a particular grapheme in isolation, but do not use that grapheme in the spelling of a word or that children do not know a particular grapheme in isolation, but do use that grapheme in spelling a word. This indicates that transfer from active grapheme knowledge to word spelling is not fully stable. This is in accordance with a study of Jansen-Donderwinkel, Bosman, and van Hell (2002). They compared the spelling errors in a dictation to the spelling errors in a free writing assignment. About a quarter (26%) of the spelling scores were not stable. That is, children wrote the word correctly in the dictation but incorrectly in the free writing assignment (19%), or they wrote the word incorrectly in the dictation, but correctly in the free writing assignment (7%). Gough, Juel, and Griffith (1992) studied the consistency of reading and writing words. They had subjects read each word twice and spell each word twice. Children sometimes could spell words, but could not read them (on average 10%). Sometimes they read words correctly on one occasion, but not on the other (10%), or they spelled words correctly on one occasion, but not the other (11%). In the present study, almost 22 percent of the scores were unstable. It seems that behaviour of people contains a certain amount of random fluctuation.

To conclude, Dutch children with SLI have a delay in grapheme spelling and word spelling, but the delay in word spelling decreases during first grade. The orthographic characteristics that influence their early spelling are almost the same as for typically developing children. Moreover, children generalize their active grapheme knowledge to the spelling of words. These results suggest that, despite the major spelling delay of children with SLI, the spelling processes are quite similar in children with SLI and typically developing children. In other words, children with SLI develop more slowly than, but not differently, from children without SLI.

Implications

These findings hold implications for clinical practice and education. Teachers of children with SLI can use the same educational spelling methods they use for typically developing children. There is no need for special practices. The results of the present study also indicate that children with SLI do make progress during first grade, and that some children catch up their delay. It appears that children with SLI only need more practice in grapheme knowledge and early spelling than typically developing children. Because grapheme knowledge is a necessary prerequisite for spelling, kindergarten teachers serve their students best when they practice skills that are directly related to spelling. That is, teaching them to recognize and write down graphemes. Previous research showed that it is also important to practice segmenting of words into letters and sounds. Bosman (2007) and Vernooy (2007) both acknowledge and have proven that dedicated and knowledgeable teachers can make all the difference. Moats and colleagues (Moats, 2009; Moats & Lyon, 1996) argue that teachers' knowledge of language structure, reading development, and pedagogy is important for the reading and spelling development of children. Bosman (2007) showed that special-education students may reach a spelling level that is not different from that of regular-education students once teachers devote themselves to the task according to evidence-based didactics. Thus, teachers of children with SLI have to make sure that students acquire grapheme knowledge, that they are able to segment words into letters and sounds, and that they practice spelling skills by writing down to dictation.

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Appendix. Word spelling test

Word	Translation	Word structure
boot	[boat]	CVC
riem	[belt]	CVC
uur	[hour]	VC
gum	[eraser]	CVC
wiel	[wheel]	CVC
kan	[jug]	CVC
soep	[soup]	CVC
zaag	[saw]	CVC
beest	[beast]	CVCC
rups	[caterpillar]	CVCC
snor	[moustache]	CCVC
brug	[bridge]	CCVC
bloem	[flower]	CCVC
bril	[glasses]	CCVC
slee	[sledge]	CCV
hoest	[cough]	CVCC
pomp	[pump]	CVCC
taart	[cake]	CVCC
pols	[wrist]	CVCC
puist	[pimple]	CVCC
gesp	[buckle]	CVCC
fles	[bottle]	CCVC

Chapter 4

Specific Language Impairment affects the early spelling process quantitatively but not qualitatively

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This chapter has been published as:
Cordewener, K. A. H., Bosman, A. M. T., & Verhoeven, L. (2012).
Specific Language Impairment affects the early spelling process
quantitatively but not qualitatively.
Research in Developmental Disabilities, 33, 1041-1047.

Abstract

The present study investigated whether children with Specific Language Impairment (SLI) need a special spelling education program, by examining whether the early spelling of children with SLI is quantitatively and qualitatively different from the spelling of typically developing children. Two groups of first grade children participated: 39 children with a typical language development between the age of 73 and 88 months, and 59 children with SLI between the age of 71 and 97 months. The results indicated that children with SLI do have a quantitative delay in both grapheme knowledge and spelling during first grade. However, there was no qualitative difference between the early spelling of children with SLI and typically developing children. This indicated that children with SLI show similar spelling processes compared to typically developing children, although they develop more slowly. For clinical practice, this means that teachers of children with SLI can practice the same skills as with typically developing children, but children with SLI need substantially more practice than typically developing children.

Specific Language Impairment Affects the Early Spelling Process Quantitatively but Not Qualitatively

Specific Language Impairment (SLI) is a condition of substantially delayed language development that cannot be attributed to a mental or physical handicap, hearing impairment, emotional disorder, or environmental deprivation (Bishop, 1992; Leonard, 1998). Children with SLI run a higher risk than typically developing children of developing reading (Catts, 1993; Catts, Fey, Zhang, & Tomblin, 1999; Catts, Fey, Tomblin, & Zhang, 2002) and spelling problems (Kamhi & Catts, 1986; Kamhi, Catts, Mauer, Apel, & Gentry, 1988). Why this is the case, is not clear yet.

To be able to provide adequate help it is necessary to establish whether children with SLI learn to read and spell differently than typically developing children. This paper focuses on the acquisition of early spelling knowledge to investigate the differential nature of the spelling process in both children with SLI and children whose language develops more typically. If the spelling process of children with SLI is different, spelling education for children with SLI has to be adapted to their specific needs. If, however, the processes involved in spelling appear to be the same for both groups, there is no need for differential instruction. The goal of the present study is, therefore, to investigate whether there are differential effects of a language delay on the spelling processes of children with SLI. We will compare the spelling process of children with SLI to those of typical developing children both quantitatively and qualitatively. A quantitative difference is revealed when children with SLI make more rather than different type of spelling errors, whereas a qualitative difference is shown by a difference in types of errors. Findings from earlier studies strongly suggest that children with SLI are prone to a developmental delay in spelling acquisition (Lewis, Freebairn, & Taylor, 2000; Nathan, Stackhouse, Goulandris, & Snowling, 2004; Nauclér, 2004; Snowling, Bishop, & Stothard, 2000). Whether spelling acquisition is also qualitatively different is as yet unknown.

To study the nature of the spelling errors, we will investigate five word characteristics that have been known to affect the difficulty of spelling a word (e.g., Bosman, 2004). These word characteristics are 1) word length, the more graphemes the more difficult it is to spell the word (Jansen & Luurtsema, 1986; Treiman, 1993; Wilson & Bock, 1985); 2) type of grapheme, children generally have more problems spelling vowels than consonants (Stage & Wagner, 1992; Treiman, Berch, & Weatherston, 1993; Wimmer & Landerl, 1997); 3) grapheme position, children tend to find the spelling of the beginning easier than that of the end and the middle (Treiman et al., 1993); 4) word structure, words with single consonants at the beginning and the end of the word are easier to spell than words with

consonant clusters at the beginning or end (Kerstholt, van Bon, & Schreuder, 1994, 1997; Schreuder & van Bon, 1989; Treiman & Weatherston, 1992); 5) word frequency, high-frequency words are usually easier to spell than low-frequency words (Kreiner & Gough, 1990; van Diepen & Bosman, 1999).

Dutch-speaking beginning spellers from Grade 1 with and without SLI participated in the study. They were asked to spell all Dutch graphemes at the beginning of Grade 1 and at the end. In the middle and at the end of Grade 1 they had to spell 22 words from a standardized spelling test. All five characteristics were represented in the words of the spelling test. This allowed us to test for a quantitative difference (i.e., a spelling delay) as well as for qualitative differences (i.e., differences in word spellings).

Method[1]

Participants

Both a group of typically developing children and a group of children with SLI participated in the present study. The children with typical language development were recruited from two schools for regular education. The children with SLI were recruited from three special-education schools for children with SLI. Deaf and hearing-impaired children were excluded from the study. To obtain a sufficient number of participating children, we had to invite different schools to participate.

Because of illness or absence, 21 children were excluded.[2] The final sample consisted of 39 children with a typical language development (22 girls, 17 boys) between the ages of 73 and 88 months at the beginning of first grade (M = 79;7, SD = 4;1), and 59 children with SLI (21 girls, 38 boys) between the ages of 71 and 97 months at the beginning of first grade (M = 82;2, SD = 5;8).

All participating children spoke Dutch. Children who attended regular education, all had Dutch as their native language. In the group of children with SLI there were children with a mother tongue other than Dutch. In School A this pertained to 19% of the children, at School B it was 56%, and in School C all children were native Dutch speakers. To make sure that linguistic diversity was not responsible for the differences in School B, we tested whether performances on grapheme knowledge and word spelling were different between native and non-native Dutch children. There were no significant differences in performance on grapheme knowledge at the beginning and the end of first grade, and on word spelling at the middle and the end of first grade, all F's < 1. The descriptive statistics

1 A part of these data was already used in a previous paper (Cordewener, Bosman, & Verhoeven, 2012).

2 The scores of the group of children that dropped out of the study did not differ significantly from the scores of the remaining group on the grapheme and word spelling tasks.

for both groups are presented in Table 1. We also computed the percentage of typically developing children and children with SLI that reached the criterion of full grapheme knowledge (n = 34), and that were able to write 20 or more words correctly. These percentages are presented in Table 2.

In the Netherlands, almost all children with SLI attend a special-education school for children with SLI. Each child is re-evaluated every two years by a team of experts to determine whether or not the child still fits the criteria for SLI (van Weerdenburg, 2006). At these schools, there are smaller classes than in mainstream education. Children receive literacy education in kindergarten to initiate phonological awareness and grapheme knowledge. Formal reading starts in first grade in both regular and in special education.

Table 1 Mean Scores on Grapheme Knowledge and Word Spelling for Typically Developing Children and Children with SLI

	Typical development		SLI	
	N	*M (SD)*	*N*	*M (SD)*
Grapheme knowledge				
Beginning of first grade	39	23.03 (3.61)	59	16.59 (6.43)
End of first grade	39	33.56 (.94)	59	28.71 (5.78)
Word spelling				
Middle of first grade	39	21.01 (1.63)	59	12.72 (6.53)
End of first grade	39	21.75 (.39)	59	16.81 (5.23)

Table 2 Percentage of Children that Reached the Criteria

	Typical development		SLI	
	N_{total}	$\%_{criterion}$	N_{total}	$\%_{criterion}$
Grapheme knowledge (criterion = 34 graphemes)				
Beginning of first grade	39	0%	59	0%
End of first grade	39	77%	59	20%
Word spelling (criterion = 20 or more)				
Middle of first grade	39	90%	59	15%
End of first grade	39	100%	59	39%

Materials

Grapheme knowledge

Active knowledge of phoneme-grapheme relationships was measured by a grapheme-knowledge test. The child had to write a grapheme named by the experimenter. The experimenter named the grapheme and a word that contained this grapheme. The graphemes used in this test are: b, d, f, g, h, j, k, l, m, n, p, r, s, t, v, w, z, a, e, i, o, u, aa, ee, oo, uu, oe, eu, ui, ou, au, ie, ei, and ij. The score equaled the number of correctly written graphemes. The lowest possible score was zero and the highest possible score was 34.

Word spelling

This skill was measured by a standardized word-spelling test 'Schaal Vorderingen in Spellingvaardigheid 1 Dictee 2 [Scale Progression in Spelling Abilities 1 Dictation 2] (van den Bosch, Gillijns, Krom, & Moelands, 1991). The child had to write 22 monosyllabic words with consistent phoneme-to-graphemes relations. That is, no confusion should exist about which grapheme has to be used in the word. Phonology entails the correct application of phoneme-grapheme correspondences. Thus, proper segmentation most likely leads to a correct spelling of the word. The monosyllabic words had a vowel-consonant (VC)-, CVC-, CCV-, CVCC-, or CCVC-structure (C stands for Consonant and V for Vowel). For each word, the number of correctly written graphemes was computed and divided by the number of graphemes within that word. The lowest possible score was zero and the highest possible score was 22.

To measure the word characteristic *Type of grapheme*, we assessed for each vowel and consonant within a word whether it was correct or incorrect. All 22 words together consisted of 78 graphemes: 22 vowels and 56 consonants. To measure *Grapheme position*, we divided all 78 graphemes into one of three positions: onset, nucleus, or coda. The onset is the first part of a syllable that consists of one or two consonants. The nucleus is the middle part of a syllable, this is always a vowel. The coda is the final part of a syllable that consists of one or two consonants. To measure *Word length*, all 78 graphemes were divided into two categories: short words consisting of 2 or 3 graphemes and long words containing 4 graphemes. To measure *Word structure*, the words were divided into three categories: CVC-, CVCC-, or CCVC-words. The two words with a VC- and CCV-structure were excluded from this analysis, because they do not fit the three types of structures. To measure *Word frequency*, we used WebCelex, a database with Dutch lemmas that contains a word's frequency per million words. If the word frequency was lower than 5, the word was coded as low frequent; if the word frequency was between 5 and 24, the word was coded as medium frequent; if the word frequency was higher than 24, the word was coded as high frequent. The words, including the *Word structure* and *Word frequency* are presented in the Appendix.

Procedure

The children were tested after summer holiday, at the beginning, middle, and end of first grade, that is, after three, five, and nine months of formal spelling instruction, respectively. Grapheme knowledge was tested at the beginning[3] and the end of first grade and word spelling was tested at the middle and the end of first grade. At the beginning of first grade, grapheme knowledge of children with SLI was tested individually; typically developing children were tested in small groups of five to eight children. The spelling tests and the grapheme-knowledge test at the end of first grade were administered in class. The children wrote the graphemes and the words down to dictation. The first author, with the help of six research assistants tested all children.

Results

Analyses of the Quantitative Aspects

A GLM-procedure for Univariate Analyses of Variance on grapheme knowledge at the beginning of first grade was conducted, with Group (typical development vs. SLI) as independent factor. It was not possible to insert grapheme knowledge at the end of first grade in the same analysis, because of a ceiling effect for typically developing children. We checked the assumptions of normally distributed data and homogeneity of variance, before conducting the analyses.

Grapheme knowledge

The mean scores on grapheme knowledge are presented in Table 1. The main effect of Group was significant at the beginning of first grade, $F(1, 96) = 32.24$, $p < .0001$, *partial* $\eta^2 = .25$, indicating that typically developing children knew more graphemes at the beginning of first grade than children with SLI. Despite the ceiling effect, typically developing children also knew more graphemes at the end of first grade than children with SLI, $F(1, 96) = 26.97$, $p < .0001$, *partial* $\eta^2 = .22$. This is also shown in Table 2, which presents the percentage of children that reached the criterion for grapheme knowledge. Table 2 also reveals that only 20% of the children with SLI knew all graphemes, whereas 77% of the typically developing children knew all graphemes at the end of first grade. Note, however, that children in regular education should know all graphemes by the end of the first year.

3 Grapheme knowledge could not be measured later during first grade because of a ceiling effect for typically developing children; after five months in first grade, these children can name all graphemes, and after eight months they can also write all graphemes (Struiksma, van der Leij, & Vieijra, 2009).

Word spelling

According to Dutch standardized norms, children halfway through first grade should be able to write monosyllabic words with consistent phoneme-grapheme relationships. The mean scores on the word-spelling test are presented in Table 1 and the percentages of children that reached the criterion are presented in Table 2. These results show that 90% of the typically developing children were already able to write almost all 22 words correctly at the middle of first grade. Thus, typically developing children reached this spelling criterion at the middle of first grade. The results also showed that only 15% of the children with SLI reached this criterion at the middle of first grade, and only 39% reached this at the end of first grade. Thus, children with SLI clearly develop a substantial delay in their spelling knowledge.

Analyses of the Qualitative Aspects

To prepare the data for analysis, an item file was created and mean scores were computed for each grapheme. Then, we conducted a GLM-procedure for repeated measures on each of the word characteristics with Group (SLI vs. typical language development) as independent factor. Greenhouse-Geisser corrections were applied when the data violated the assumption of sphericity. The five word characteristics were: Type of grapheme (vowel vs. consonant), Grapheme position (onset vs. nucleus vs. coda), Word length (short words with 2 or 3 graphemes vs. long words with 4 graphemes), Word structure (CVC vs. CVCC vs. CCVC), and Word frequency (low vs. medium vs. high). We only included the spelling scores at the middle of first grade, because of a ceiling effect at the end of first grade for typically developing children. Grapheme and word characteristics were treated as between-subjects variables. The mean scores for the two groups are presented in Table 3.[4] In case of an interaction effect between word characteristic and Group, we assumed a qualitative difference between the spelling of children with SLI and typically developing children.

Word characteristics

Type of grapheme. The interaction effect between Type of grapheme and Group did not reach a significant level, $F < 1$. The main effect of Type of grapheme was not significant either, $F < 1$, revealing that spelling vowels was equally easy (or difficult) as spelling consonants. The main effect of Group, however, was significant, $F(1, 76) =$

4 Note that because the variables could not be orthogonally manipulated, it was impossible to test for interaction effects among word characteristics on children's performance. For instance, *Grapheme position* is associated with *Type of grapheme*. There is no equal division of consonants and vowels in coda position. Consonants appear more often in onset or coda position than in nucleus position, and for vowels this is vice versa.

Table 3 Mean Scores for Typically Developing Children and Children with SLI (Item Analyses)

		Typical development	SLI
	N	*M (SD)*	*M (SD)*
Type of grapheme			
Vowel	22	.95 (.04)	.55 (.12)
Consonant	56	.95 (.05)	.57 (.16)
Grapheme position			
Onset	27	.96 (.05)	.60 (.18)
Nucleus	21	.96 (.04)	.55 (.12)
Coda	30	.95 (.06)	.54 (.13)
Word length			
2-3	26	.97 (.03)	.67 (.15)
4	52	.95 (.06)	.52 (.12)
*Word structure**			
CVC	7	.93 (.04)	.50 (.14)
CVCC	8	.83 (.08)	.23 (.07)
CCVC	5	.90 (.08)	.18 (.06)
Word frequency			
Low	7	.82 (.11)	.30 (.11)
Medium	8	.89 (.10)	.33 (.19)
High	7	.89 (.06)	.30 (.20)

* Note that two words of the spelling test had another structure (i.e., VC and CCV) and because of the otherwise unequal division, these words were excluded from the analyses for *Word structure*.

577.68, $p < .0001$, *partial* $\eta^2 = .88$, revealing that typically developing children scored higher on both vowels and consonants than children with SLI.

Grapheme position. The interaction effect between Grapheme position and Group did not reach a significant level, $F < 1$. The main effect of Grapheme position was not significant either, $F(1, 75) = 1.09$, $p = .34$, *partial* $\eta^2 = .03$. Again, the main effect of Group was significant, $F(1, 75) = 681.80$, $p < .0001$, *partial* $\eta^2 = .90$, revealing that typically developing children scored higher on all grapheme positions, onset, nucleus, and coda, than children with SLI.

Word length. The interaction effect between Word length and Group was significant, $F(1, 76) = 19.03$, $p < .0001$, *partial* $\eta^2 = .20$. Subsequent ANOVA revealed that for both typically developing children and children with SLI, shorter words were easier to spell than longer words. However, for typically developing children, the difference between spelling shorter and longer words was smaller than for

children with SLI, respectively, $F(1, 76) = 5.55$, $p < .05$, and $F(1, 76) = 22.91$, $p < .0001$.

Word structure. The interaction effect between Word structure and Group was significant, $F(2, 17) = 11.17$, $p < .001$, *partial* $\eta^2 = .57$. Subsequent ANOVA revealed that typically developing children scored higher on CVC words than on CVCC words ($p < .05$; Bonferroni corrected), whereas children with SLI scored higher on CVC words than on CVCC words, but also scored higher on CVC words than on CCVC words, respectively, $F(2, 17) = 4.29$, $p < .05$, and $F(2, 17) = 20.11$, $p < .0001$ (Bonferroni corrected).

Word frequency. The interaction effect between Word frequency and Group did not reach a significant level, $F < 1$. The main effect of Word frequency was not significant either, $F < 1$. The main effect of Group was again significant, $F(1, 19) = 259.19$, $p < .0001$, *partial* $\eta^2 = .93$, revealing that typically developing children scored higher on words with all different word frequencies than children with SLI.

Discussion

The present study investigated whether there were quantitative and/or qualitative differences between the early spelling of children with SLI and typically developing children. The results indicated that children with SLI indeed have a delay in grapheme knowledge at the beginning and the end of first grade. Almost 80% of the typically developing children knew all graphemes at the end of first grade, whereas only 20% of the children with SLI did. Children with SLI also have a delay in early spelling at the middle and the end of first grade. Almost all typically developing children reached the criterion of writing 20 words correctly at the middle of first grade, whereas most children with SLI did not even reach this criterion at the end of first grade (only 39%). Previous research also indicated a spelling delay for children with SLI (Lewis et al., 2000; Nathan et al., 2004; Nauclér, 2004; Snowling et al., 2000). Although there is a quantitative difference between children with SLI and typically developing children, children with SLI do progress during first grade. At the beginning of Grade 1, they knew on average 16.5 graphemes. During the first year they learned an additional 12 graphemes, six graphemes short of full grapheme knowledge.

The results also indicated that there are almost no qualitative differences between the early spelling of children with SLI and children with a typical language development. The influence of the word characteristics *Type of grapheme*, *Grapheme position*, and *Word frequency* on spelling was similar for children with SLI and typically developing children. The effect of *Word length* was the same for both groups of children, but the effect was stronger for children with SLI than for typically developing children. Both groups made more errors in long words than

in short words, but the difference between long and short words was larger for children with SLI. This could be explained by the fact that the participating schools for children with SLI teach the spelling knowledge more slowly than the schools for typically developing children. Consequently, typically developing children have had more practice with longer words than children with SLI, and that may have caused the smaller difference between longer and shorter words for typically developing children.

The effect of *Word structure* was slightly different for both groups of children, because both groups scored higher on CVC-words than on CVCC-words, but children with SLI also scored higher on CVC-words than on CCVC-words, whereas typically developing children had equal numbers of errors on CVC- and CCVC-words. This finding could also be explained by the fact that children with SLI had less practice with words with a more difficult word structure, and consequently had lower scores on CCVC- and CVCC-words. The difference between the scores on CVCC- and CCVC-words on the one hand and CVC-words on the other hand was lower for typically developing children than for children with SLI. To summarize, early spelling of children with SLI deviates quantitatively from typically developing children, but not qualitatively.

This finding raises an important question: If spelling processes of children with SLI are not different from the spelling processes of typically developing children, why do children with SLI have a spelling delay? Two non-mutually exclusive explanations spring to mind. One is that learning to read and spell is delayed, because the skills that are required for the literacy acquisition process are delayed. Previous research indeed showed that children with SLI are generally delayed in the acquisition of letter knowledge (e.g., Vandewalle, Boets, Ghesquière, & Zink, 2010) and phoneme segmentation (Bishop, 1992; Kamhi & Catts, 1986; Kamhi et al., 1988).

Another reason for the quantitative difference between typically developing children and children with SLI is that children with SLI do not receive adequate instruction. Several researchers have emphasized that learning to spell largely depends on proper education (Allal, 1997; Bosman, 2004). To substantiate this suggestion, we ran an analysis of variance on both grapheme knowledge and word spelling of all children at the three schools for children with SLI. It appeared that for both grapheme knowledge at the beginning and word spelling at the middle of first grade, no differences emerged between the three schools, respectively, $F(2, 56) = 2.03$, $p = .14$ and $F(2, 56) = 2.45$, $p = .10$. However, for both grapheme knowledge and word spelling at the end of first grade, there were differences between the schools, $F(2, 56) = 4.17$, $p < .05$ and $F(2, 56) = 10.47$, $p < .001$, respectively. Post-hoc Bonferroni corrected analyses revealed that for grapheme knowledge, performance of children at School B were lower than performance of children at school A ($p < .05$). No

difference existed between Schools A and C, and between B and C. With respect to word spelling, performance of children at School B was lower than performance of children at School A ($p < .001$) and School C ($p < .001$). No differences existed between Schools A and C. This suggests that spelling performance is strongly influenced by the nature and quality of spelling education. Recent research showed that good teachers can make all the difference (Moats, 2009; Taylor, Roehrig, Soden Hensler, Connor, & Schatschneider, 2010).

Implications for Clinical Practice

Our study showed that there are only temporal differences between the spelling of children with SLI and typically developing children, but no structural differences. This means that spelling education of children with SLI has to be more comprehensive, but not different than the education of typically developing children. Nevertheless, because it is more difficult for children with SLI to acquire letter knowledge, phoneme segmentation, and spelling, children with SLI need more practice than typically developing children. Both the fact that children with SLI do make progress and the fact that there is a performance difference between the schools, indicate that proper education helps and suggest that children with SLI are able to learn graphemes and learn to spell. Yet teachers of children with SLI teach grapheme knowledge and spelling skills too slowly. There is anecdotal evidence that Dutch children with SLI are capable of acquiring an adequate level of literacy in much the same time as children without. It does take, however, more intensive instruction and practice. Unfortunately, however, in the Netherlands, teachers of children with SLI tend to practice literacy skills less rather than more. This practice puts children with SLI in a double-whammy position. They already tend to be delayed in skills that are required for the proper acquisition of reading and spelling, and should thus receive additional instruction. Instead, teachers tend to provide less instruction and fewer opportunities for practice. Thus, the educational practice is strongly recommended to intensify instruction and practice for children with SLI.

Implications for Further Research

Our study has brought a significant contribution to the knowledge about spelling education for children with SLI. However, because spelling is strongly influenced by education, more research is welcome. Clinical experience of speech therapists shows that when children become aware of phonemes and the corresponding graphemes, pronunciation quality increases. This suggests that spelling education for children with SLI is not only important for spelling performance, but also for language skills. Thus, instruction in grapheme knowledge and spelling for children with SLI best starts at the same time as with typically developing children,

since knowledge of graphemes and spelling will improve their language skills. Future research can focus on the effect of early intensive spelling instruction on the spelling performances of children with SLI.

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Appendix. Word spelling test

Word	Translation	Word structure	Word frequency
boot	[boat]	CVC	67
riem	[belt]	CVC	22
uur	[hour]	VC	425
gum	[eraser]	CVC	1
wiel	[wheel]	CVC	21
kan	[jug]	CVC	5
soep	[soup]	CVC	24
zaag	[saw]	CVC	3
beest	[beast]	CVCC	40
rups	[caterpillar]	CVCC	3
snor	[moustache]	CCVC	18
brug	[bridge]	CCVC	52
bloem	[flower]	CCVC	94
bril	[glasses]	CCVC	36
slee	[sledge]	CCV	3
hoest	[cough]	CVCC	3
pomp	[pump]	CVCC	5
taart	[cake]	CVCC	10
pols	[wrist]	CVCC	24
puist	[pimple]	CVCC	4
gesp	[buckle]	CVCC	3
fles	[bottle]	CCVC	112

Part III

Instruction

Chapter 5

Implicit and explicit instruction: The case of spelling acquisition

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This chapter has been accepted as:
Cordewener, K. A. H., Bosman, A. M. T., & Verhoeven, L. (2014).
Implicit and explicit instruction: The case of spelling acquisition.

Abstract

This study examined the influence of implicit and explicit instruction for the acquisition of two types of Dutch spelling rules: a morphological and a phonological rule. A sample of 193 first grade, low- and high skilled spellers was assigned to an implicit-instruction, explicit-instruction, or control-group condition. The results showed that for both rules, students in the explicit condition made more progress than students in the control condition. For the morphological rule, students in the explicit condition had higher posttest scores on pseudowords than students in the implicit condition. The effects of the three conditions were the same for low- and high-skilled spellers. Both low- and high-skilled spellers in the implicit and explicit condition did not fully generalize their knowledge of both rules to new and pseudowords.

Implicit and Explicit Instruction: The Case of Spelling Acquisition

To become a proficient speller, students have to acquire knowledge about the sound-letter relationships. Sometimes students are able to learn the underlying spelling of words by just being engaged in reading and writing (e.g., Steffler, 2001). Generally, however, students need formal instruction to achieve a proper level in reading and spelling (Bosman & de Groot, 1992; Graham, 2000). Adequate spelling instruction is particularly necessary for poor spellers (Graham, 1999, 2000). Formal instruction in spelling may take different approaches. In some approaches, spelling rules are taught by implicit instruction, whereas in other approaches, spelling rules are taught by explicit instruction.

Implicit and Explicit Instruction

Although the concepts of implicit and explicit *instruction* we use here are to some extent related to the concepts of implicit and explicit *learning* defined by, for example, Reber (1989, 1993) and Seger (1994), there is an important difference. Implicit *learning* refers to learning about the structure of stimuli without the intention to do so. A clear example of implicit learning is the fact that most native speakers are perfectly capable of producing grammatically correct sentences, while at the same time being unable to explain why a particular sentence is grammatical or not. Explicit learning, on the other hand, is intentional and goals determine what will be learned (Cleeremans & Destrebecqz, 2005). After learning, students are usually capable of expressing the acquired knowledge structure.

Implicit and explicit *instruction*, however, are both intentional, but they differ in the extent to which the structure of the knowledge is made explicit. Implicit instruction provides instruction on what to learn. In case of spelling, students need to learn the spelling of particular words, but they are not told about the underlying structure that is present in the spelling. Explicit instruction, on the other hand, entails explicit clarification of the underlying rules or knowledge structure to be acquired. With respect to spelling, students are told about the spelling rule that they need to learn. Explicit instruction should lead to explicit learning, whereas implicit instruction may lead to implicit learning, but may also lead to explicit learning. After all, students can discover spelling rules by themselves and, consequently, may acquire explicit knowledge of rules, without receiving explicit instruction by the instructor.

Implicit Instruction Types

Much of our spelling knowledge is implicitly acquired as revealed by studies in Dutch (van Doorn-van Eijsden, 1984), French (Pacton, Perruchet, Fayol, & Cleeremans, 2001),

and English (Bryant, Deacon, & Nunes, 2006; Bryant, Nunes, & Snaith, 2000; Kemp & Bryant, 2003; Treiman, 1993; Steffler, 2001, 2004). Bryant et al. (2000), for example, asked students to write pseudo-verbs. The English language contains same-sound verbs with same-sounding stem in infinitive and past that are written with an -ED ending in the past tense (KISS-KISSED, CLAP-CLAPPED), and different-sound verbs with a different-sounding stem in infinitive and past that do not have an -ED ending in the past tense (FEEL-FELT, SLEEP-SLEPT). This rule is not taught to students, and even most teachers are not aware of the rule. In the study by Bryant et al. (2000), it appeared that 8- and 9-year-old students wrote same-sound pseudo-verbs and different-sound pseudo verbs differently. They used more -ED endings in same-sound pseudo-verbs than in different-sound pseudo-verbs, suggesting that students have unconscious awareness of a spelling rule that has not been taught.

A frequently used way of implicit instruction is the copy-cover-compare procedure. This approach requires students to examine the spelling of the word closely, copy the word, cover the word, write the word from memory, and finally check the word and correct it if needed. The copy-cover-compare approach has proven to be successful for students from special education (Hubbert, Weber, & McLaughlin, 2000; Murphy, Hern, Williams, & McLaughlin, 1990). A similar approach is visual dictation, which is exclusively studied in the Netherlands. The visual-dictation procedure requires students to study a word carefully for a few seconds. Then the word is covered and the student is asked to write the word from memory. As a final step, the word is made visible again and the student has to check the spelling and makes corrections if required. The visual-dictation approach has proven to be successful for students from regular education, students with spelling problems, students with spelling problems and severe externalizing behavioral problems, and students with spelling problems and low intelligence (e.g., van Hell, Bosman, & Bartelings, 2003; van Leerdam, Bosman, & Van Orden, 1998). Visual dictation is particularly effective for learning the spelling of words with ambiguous phoneme-to-grapheme relationships (for example, EA in CHEAP is ambiguous, because an alternative spelling is EE or even IE; a Dutch example is the spelling of the word GEIT [goat], an alternative spelling is GIJT, because both the EI en and the IJ are pronounced /ɛi/). The difference between copy-cover-compare and visual dictation is that the latter is under the guidance of the teacher, whereas the former is a self-teaching approach.

Explicit Instruction Types

There are also rules that can be acquired by explicit instruction. An example of a rule that can be taught explicitly is the rule for doubling the final consonant of one-syllable words before adding -ED, also known as the doubling rule (Steffler,

2004). The final consonant has to be doubled to maintain the phonological integrity of the word. An example is the word HOP, in which the P has to be doubled, before adding -ED, which makes it HOPPED. For words with a long vowel, such as HOPE, the P should not be doubled, so it becomes HOPED. A similar rule pertains to adding -ING. The final N in the word WIN needs to be doubled in order to obtain the correct spelling WINNING; without the double N a proper, but unintended word WINING is the result. Steffler (2004) showed that students who are able to explain the spelling rule performed better than students who are not able to explain the rule. Wanzek and colleagues (2006), who reviewed 19 intervention studies on reading and spelling, showed that spelling interventions that included explicit instruction with sufficient opportunities for students to practice were most effective.

In general, there are two kinds of explicit-spelling instruction, in which different aspects are instructed. The first one is explicit-*rule* instruction, in which students receive explicit instruction in the use of spelling rules (Darch, Eaves, Crowe, Simmons, & Conniff, 2006; Hilte & Reitsma, 2011; Kemper, Verhoeven, & Bosman, 2012). An example of this approach is when a spelling rule is made explicit for students and students practice with applying the spelling rule. The second one is explicit-*strategy* instruction, in which students receive explicit instruction in the use of spelling strategies (Butyniec-Thomas & Woloshyn, 1997; Graham, Harris, & Chorzempa, 2002; Kernaghan & Woloshyn, 1995). Part of a strategy instruction might be the explanation of a spelling rule, but also strategies, such as syllable segmentation, imagining the word or a combination of strategies. Explicit-spelling instruction was successful for students of regular education (Butyniec-Thomas & Woloshyn, 1997; Hilte & Reitsma, 2011; Kernaghan & Woloshyn, 1995), students with spelling difficulties (Graham et al., 2002; Kemper et al., 2012), as well as learning disabled students (Darch et al., 2006).

An example of a study on explicit-strategy instruction was conducted by Butyniec-Thomas and Woloshyn (1997). Students were first taught a spelling rule, after which they had to practice with the rule, then they received syllabic-segmentation instruction, and finally, they received an imagery exercise during which they had to study a word carefully and then imagine that they wrote the word on a screen. Another example was applied by Graham et al. (2002), in which students were practicing with words with a particular spelling structure (e.g., words with short vowels, long vowels, the suffix -ED, the suffix -ING). They were encouraged by the trainer's thinking aloud strategy to apply this strategy themselves, that is, 1) say the word and study the letters, 2) close your eyes and say the letters, 3) study the letters, 4) writing the word three times without looking at it, and 5) check the spellings and correct misspellings. The more explicit training in the study by Graham et al. also contained a visual-dictation part. Dutch examples of explicit instruction are learning the spelling of words containing an orthographic rule

(Hilte & Reitsma, 2011) or words containing an orthographic or a morphological rule (Kemper et al., 2012) as described in the upcoming paragraph 'Spelling ability'.

To examine whether students have acquired a spelling rule, it is not enough to test their knowledge on words that were practiced. When a speller has truly acquired the rule, novel words with a structure identical to the practiced words should be spelled as well as the practiced words. When students fully acquire a rule, that is, they are not only able to apply the rule to practiced words but also to novel words, students have rule-based knowledge. If performance on novel words is worse than on trained words, it is assumed that students have rule-like knowledge. This pattern is called transfer decrement, because it indicates that knowledge was not transferred to a new situation or that generalization of knowledge has not occurred. Thus, a transfer decrement indicates that students acquired rule-like knowledge, whereas the absence of a transfer decrement suggests that they have rule-based knowledge (Cleeremans, 1993; Reber, 1993).

With respect to spelling, it is possible to use two types of words to test for transfer decrements. Test items may be extant words or pseudowords. Extant words are words that exist in the language, whereas pseudowords are words that consist of legal strings of letters, but have no meaning in that particular language; (e.g., in English STOME, in Dutch FLOEM). The use of pseudowords to test for knowledge transfer in a spelling training has an important advantage above the use of novel extant words, since students may accidentally know the spelling of extant words that were not practiced, but this cannot be the case with pseudowords.

Spelling Ability

Differences in the speed with which students master the spelling of their native language are large. Whether the difference between good and poor spellers relies on the amount of instruction and/or the nature of the instruction is still a matter of debate. Studies conducted in the Netherlands provided evidence for both assumptions. The effect of a systematic and structured didactic approach was tested in an experimental study with students with learning disabilities (Bosman, 2007). The spelling skills of students in the experimental condition after one year of instruction was three times better than those in a control condition in which the standard didactic approach was applied. Moreover, the spelling level of the students in the experimental condition was similar to that of students without learning disabilities. The effect of prolonged instruction and practice was tested in the study on learning the spelling of strange words in which regularization of the spelling was applied (Bosman, van Hell, & Verhoeven, 2006). Students with learning disabilities clearly benefitted from a longer training.

With respect to the goal of the present study, the question arises whether differential effects will emerge in students with good and poor spelling skills as a

result of the application of implicit and explicit instruction. Explicit instruction in spelling, as defined here, requires the use and application of rules, which may burden cognitive processing more so than implicit instruction. For that reason, explicit instruction may be more effective in students with good spelling skills than in students with poor spelling skills. This line of reasoning is in accordance with findings from Reber, Walkenfeld, and Hernstadt (1991) on tasks unrelated to spelling. They not only found larger differences between students on an explicit-instruction task and smaller individual differences on an implicit-instruction task, they also showed that explicit learning was more strongly related to intelligence than implicit learning. The hypothesis in the present study is, therefore, that implicit instruction leads to smaller differences between poor and good spellers than explicit instruction does, because good spellers benefit more from explicit instruction than poor spellers.

Conflicting findings with respect to this assumption have been provided by two spelling studies conducted in the Netherlands (Hilte & Reitsma, 2011; Kemper et al., 2012). Hilte and Reitsma compared an explicit with an implicit instruction condition for words containing an orthographic rule. In both conditions, the students were trained by a computer. In the explicit condition, students received explicit instruction of an orthographic spelling rule, whereas in the implicit condition, a word was pronounced and the students had to type the word. The computer gave feedback by putting a green mark (correct) or a red cross (incorrect) after the students' spelling. In both cases, the correct spelling was also presented. This study provided some evidence that explicit instruction is more effective than implicit instruction. However, Hilte and Reitsma found no differences between poor and good spellers in profits from the implicit and explicit condition. Kemper et al. also compared the effectiveness of explicit and implicit instruction regarding two spelling rules (i.e., a morphological and an orthographic rule). In the explicit condition, students received explicit instruction of the spelling rules. In the implicit condition of the morphological rule, students received a list of words in plural form, and they had to write the singular form next to the plural form. In the implicit condition of the orthographic rule, students received a list of words in singular form and they had to write down the plural form. After finishing all words, students received feedback on their work, so that all students had finally written down the correct word. It appeared that, on words containing an orthographic rule, no differences existed between the implicit and explicit condition, whereas on words containing a morphological rule, explicit instruction was more effective than implicit instruction. On words containing an orthographic rule, no differences existed between poor and good spellers. However, on words containing a morphological rule, Kemper et al. found that poor spellers developed rule-like knowledge in both the implicit and explicit condition, whereas good

spellers developed rule-based knowledge in the explicit condition. No learning at all occurred in the implicit condition.

Note, however, that Kemper et al. (2012) used students from special education for the group of poor spellers and students from regular primary education as good spellers. These students from special education had a major spelling delay of about two years. It is not clear whether the results of Kemper et al. are only applicable for students with a major spelling delay or also for students with a spelling level at the bottom of the normal population. For teachers in regular education, it might also be interesting to know whether they have to use different instruction for poor and good spellers in their class. Therefore, in the present study, students' spelling ability was also taken into account.

Present Study

In the present study, we compared implicit and explicit instruction for a morphological and a phonological spelling rule. To put explicit instruction, which is teaching the spelling rule, to its severest test, visual dictation was used in the implicit condition. As said, visual dictation has been shown to be the most effective method of implicit spelling instruction for both typically developing students and students with learning disabilities (van Hell et al., 2003; van Leerdam et al., 1998). In Dutch spelling education, visual dictation is mainly used for words that have to be known by heart and for which there are no spelling rules. We, therefore, assume that students will not deduce that they are supposed to learn a particular spelling rule. In the study of Kemper et al. (2012), students in the implicit condition just had to convert the words with the morphological rule into the singular form by removing the final -EN of the words. We believe that it is easier for students to detect the rule when they have to remove -EN from each word than when they have to write a word from memory. Moreover, the effects of the training of Kemper et al. are small, so therefore we used a different implicit instruction method. Note that, visual dictation has not yet been compared with an explicit instruction approach. In the explicit-instruction condition, as opposed to the implicit-instruction condition, the word was not initially shown to the students, but the underlying rule was explained and the students had to apply the rule. For both the implicit and explicit-instruction condition, students had to write down the entire word from memory and they received immediate visual feedback, after which they had to correct themselves.

Two spelling rules that can be used to examine the effects of implicit and explicit instruction are a morphological and a phonological rule. A morphological rule is a rule for spelling words that are inconsistent in their phoneme-to-grapheme relations, that requires spellers to have knowledge of the meaning of words and their derivatives (Steffler, 2001). An example in the English language is

knowing that the addition of the suffix -ED indicates the past tense. A phonological rule is a rule for spelling words that are inconsistent in their phoneme-to-grapheme relations, that requires spellers to have knowledge about how phonemes map onto graphemes (Steffler, 2001). For example, in English, the phoneme /k/ can be represented by K, C, CK, or CH. The correct grapheme that has to be used depends on where it occurs in the word. The Dutch morphological and phonological rules that we used in the present study will be explained in the section that precedes each of the experiments. We chose to use a morphological and a phonological rule, because these rules are easier to learn than orthographic rules, at least in the Dutch language. Morphological and phonological rules are based on the phonology of the language, and may be easier to detect implicitly. Orthographic rules are artificial in nature because they are not based on phonology, but are made up by spelling reformers. These rules are hard to learn in a spelling training consisting of only six sessions.

To summarize, in the present study we used a pretest-posttest control group design in which we compared implicit and explicit instruction for a morphological and a phonological spelling rule. We included two training conditions (i.e., an implicit and explicit-instruction condition) and a control condition (i.e., in which students received no training, but only took part in the pretest and posttest), to investigate the effect of implicit and explicit instruction. In contrast to previous studies, we put explicit instruction to its severest test by comparing it with visual dictation. Moreover, the students in our study received a more extended training than the students in the study by Kemper et al. (2012). We also investigated whether students generalize their knowledge of the rule to new and pseudowords. Another innovative aspect is that we took into account the role of spelling ability by comparing low- and high-skilled spellers of regular education.

Thus, the first research question was whether there are differences in progress in spelling performance between students in the implicit, explicit, and control condition for both the morphological (Experiment 1) and phonological rule (Experiment 2). The second question was to what extent students in the implicit and explicit conditions generalize their knowledge of the rule to new and pseudowords, that is, do they acquire rule-based or rule-like knowledge as a result of the training? Additionally, we investigated whether the effects of the conditions were the same for low- and high-skilled spellers.

Experiment 1: The Morphological Rule

In this experiment, the effectiveness of instruction of a morphological spelling rule was tested. To apply a morphological rule in Dutch, the speller needs knowledge of the meaning of words and their derivatives (Steffler, 2001). The Dutch language contains singular nouns with a final /t/-sound. This final /t/-sound is sometimes written as T and other times as D. When the singular form is converted into the plural form of the particular word, it can be heard whether to write a T or a D. For instance, the singular form of HOND [dog] ends with a /t/-sound, but in the plural form 'HOND-EN' [dogs], a /d/-sound can be heard. Therefore, HOND ends with a D, despite the fact that it is devoiced. The rule that was taught to the students was: 'Do you hear a /t/-sound at the end of the word? Convert the word to the plural form, so you can hear whether a T or a D has to be written'.

Method

Participants

In this study, 193 students (94 girls, 99 boys) between the ages of 71 and 110 months (M = 83.4, SD = 4.7) participated. All students spoke Dutch at school; 16 students had a native language other than Dutch that they used at home and 6 students used a combination of Dutch and their native language.[1] Examples of native languages are Turkish and Moroccan. Students were recruited from 13 Grade-1 classes of eight different regular schools for primary education located in the middle and the south of the Netherlands. The schools had varying numbers of lower- and middle-class families. The students were divided into low- and high-skilled spellers based on their scores on a general standardized word-spelling test (see Materials). According to the norms of the test, the 73 percent highest scoring students were classified as 'high-skilled spellers' and the other students were classified as 'low-skilled spellers'. Students were assigned to the implicit, explicit, or control condition. The students assigned to the implicit and explicit conditions were matched based on their scores on reading and spelling tests (see Matching). These tests are discussed in the Materials section. Due to practical reasons, the students assigned to the control condition were not matched. Table 1 presents the number of students and the mean age in months at the start of the experiment. We only included students that took part in all sessions of the pretest and posttest.

1 We also included students with a native language other than Dutch, because all students spoke Dutch at school. Moreover, we wanted our sample to be representative for the Dutch population of students. However, we also did all analyses without the students with a native language other than Dutch, and we found exactly the same results as in the analyses including all students.

Table 1 Number of Students and Mean Age in the Experimental and Control Conditions for the Morphological Rule

		N		Age (months)
Condition		*Boys*	*Girls*	*M (SD)*
Implicit	*low-skilled speller*	9	8	83.1 (4.6)
	high-skilled speller	23	23	83.1 (4.7)
Explicit	*low-skilled speller*	11	9	84.3 (7.7)
	high-skilled speller	27	24	83.5 (4.6)
Control	*low-skilled speller*	9	6	84.3 (3.6)
	high-skilled speller	20	24	82.9 (3.6)

Materials

Test materials

Word reading. This skill was measured by a standardized reading test 'Drie-Minuten-Toets kaarten 1 en 2' (Verhoeven, 1995 [Three-Minutes-Test cards 1 and 2]). Card 1 contained one-syllable words with VC (vowel-consonant), CV, and CVC-structure. Card 2 contained one-syllable words with CCVC, CVCC, CCCVC, CVCCC, CCVCC, CVCCCC, CCCVCC, CCVCCC, CCCCVVC, CCCCVC, CCCCVCC, and VCCCC-structure. The vowel could be a single vowel or a double vowel. For each card containing 150 words, the score equalled the number of words read correctly in one minute; the lowest possible score for each card was zero and the highest possible score was 150. The students were tested individually for word reading in a separate quiet room in school.

General word spelling. This skill was measured by a standardized spelling-to-dictation test 'Schaal Vorderingen in Spellingvaardigheid 1 Dictee 2' (van den Bosch, Gillijns, Krom, & Moelands, 1991 [Scale Progression in Spelling Abilities 1 Dictation 2]). The test contained 22 monosyllabic words with consistent phoneme-to-grapheme relations. The monosyllabic words had a VC, CVC, CCV, CCVC, or CVCC-structure. The vowel could be a single or a double vowel. The words were orally presented to the students and they had to write the words down. The lowest possible score was zero and the highest was 22, the mean score was 18.54 (*SD* = 3.97). Students with a score of 17 or lower were classified as low-skilled spellers and students with a score of 18 or higher were classified as high-skilled spellers. The spelling-to-dictation test was administered groupwise.

Spelling test for a morphological rule. The spelling skill on words containing a morphological rule was measured by a spelling-to-dictation task. Each student had to write down 55 stimuli: 45 extant words and 10 pseudowords (see Appendix A). Details about the words are described in the paragraph below, because the words

were also used for the training. Note that, the extant words used in the spelling test, were also used in the training, to be sure that the trained words were equally difficult as the test words. For each student, 30 words were used as trained words and 15 words were only used as test words (or new words). These 15 new words were used to examine transfer effects. Transfer effects were not only examined by using these extant new words, but also by using pseudowords. Therefore, additionally, the test contained 5 pseudowords with a final -D and 5 pseudowords with a final -T. The pseudowords were all monosyllabic and had, except for the final -D, consistent phoneme-to-grapheme relations. Because of the number of words, the test was split into two sessions of 28 and 27 words. During the tests, all words were presented in a sentence context. For the pseudowords, a sentence was made up that constituted both the plural and singular form of the pseudoword, to make sure that the student knew the correct plural form. An example of a pseudoword with a final -D was PLOND: *In de auto zitten vier plonden. Eén plond zit achter het stuur. [Four plonden are sitting in the car. One plond is driving.]*. An example of a pseudoword with a final -T was WOET: *In het water zwemmen twee woeten. Eén woet eet brood. [Two woeten are swimming in the water. One woet is eating bread.]*. Both the pretest and the posttest contained the same words in the same sentences, but the order of the sentences differed between the tests. The score was the proportion of words in which the final -D or -T was written correctly. Note that, the correctness of the response depended only on the target grapheme, errors in the rest of the word were ignored. The lowest possible score was zero and the highest was 55. The scores were converted into proportions.

The spelling-to-dictation tests were administered groupwise. Each spelling-test session took about 30 minutes. The instruction for the spelling tests was: 'We are going to do a dictation. I will say words and you have to write them down. When you are not exactly sure how to write a particular word, you write it down the way you think it has to be written. Ok, let us start'. After the instruction, the experimenter read a sentence and named the target word which the students had to write down. The target word was repeated once. The instruction for the pseudowords was: 'Now we are going to do something funny. We are going to write down words that do not exist. These words have no meaning. I will say a sentence and a word out of that sentence, and you have to write down that word. Write it down the way you think it has to be written'.

Experimental materials

Morphological rule. The words that were used for the spelling training for words containing the morphological rule were all 45 extant words: 15 words with a final -D, 15 words with a final -T, and 15 filler words with no final -D or -T. All words were monosyllabic nouns and had, except for the final -D, consistent phoneme-to-grapheme relations; each word had a plural form. The words containing the

morphological rule had a CVC, CVCC, CCVC, or CCVCC-structure. The vowel could be a single vowel or a double vowel. To ensure that the students knew the meaning of the words, the 'Streeflijst woordenschat voor zesjarigen' (Schaerlaekens, Kohnstamm, & Lejaegere, 1999 [List of words that the vocabulary of six-year olds intended to contain]) was used. This is a list of words that, according to teachers of kindergarten and first grade, six-year-olds should understand when used in a simple sentence. Schaerlaekens et al. designed this instrument by giving teachers a list of words and having them indicate which words they believe six-year olds know the meaning of. For our study, words were selected of which at least 80 percent of the teachers expected students to know the meaning. Appendix A presents the stimuli used in this study.

The stimuli were divided into three sets. Each set consisted of stimuli that contained words drawn from each category (i.e., final -D, final -T, filler) and structure (i.e., CVC, CVCC, CCVC, CCVCC). For each group of students, two sets of words were used as trained words and the other set as transfer words. The pseudowords were also used as transfer words, and thus not trained.

Procedure

The training was conducted by eight undergraduate students. They received a thorough training and a manual in which test and training procedures were described in detail. Each undergraduate student tested and trained all students at one school. Prior to the training, the students were tested on the tests for word reading, the general test for spelling, and the pretest for spelling words containing the morphological rule. These tests were used to assign the students to the implicit and explicit conditions, such that no differences occurred on the pretest (i.e., matched; see next paragraph). Two weeks after the pretest, the morphological spelling training started. The training consisted of six sessions divided over two weeks. The week after the training, the posttest was performed.[2] All spelling tests and training sessions were administered groupwise.

2 In the original design of the study, a retention test was included that took place eight weeks after the posttest for words containing the morphological rule, and four weeks after the posttest for words containing the phonological rule. However, between posttest and retention test, students were confronted with words containing the morphological and the phonological rule in their reading education. In their reading exercises, they were explicitly confronted with these words, but not necessarily in their spelling education. However, students might have picked up information about these rules. Therefore, the results of the retention test were not reliable anymore, since the results were not necessarily caused by the training conditions. These results could not be interpreted unambiguously and therefore we choose to exclude the retention test from this study. The results indeed showed that the scores of the students in the experimental conditions decreased between posttest and retention test, whereas the scores of the students in the control group increased between posttest and retention test.

Matching. The students from six schools constituted the experimental conditions. The students from the remaining schools were assigned to the control condition. Half of the students of each class of the experimental schools were assigned to the implicit condition, whereas the other half was assigned to the explicit condition (i.e., implicit vs. explicit; School 1: 9 vs. 9; School 2 Class 1: 9 vs. 15, Class 2: 5 vs. 5; School 3: 9 vs. 9; School 4 Class 1: 3 vs. 2, Class 2: 4 vs. 2, Class 3: 3 vs. 5, Class 4: 3 vs. 4; School 5: 9 vs. 11; School 6: 9 vs. 9). The students of the implicit and explicit conditions were matched. The students of the implicit, explicit, and control condition did not differ on the first ($F(2, 190) = .79$, $p = .46$) and second ($F(2, 190) <.0001$, $p = 1.00$) word-reading test, the word-spelling test ($F(2, 190) = .01$, $p = .99$), and on the pretest for the spelling of words containing the morphological rule (words that would be trained: $F(1, 132) = .10$, $p = .75$, new words: $F(2, 190) = .06$, $p = .94$, and pseudowords: $F(2, 190) = .04$, $p = .96$). Table 2 presents the scores on all tests.

Implicit training. During the implicit training sessions, visual dictation was used. First the students received instruction: 'Today we are going to do a special dictation. I will show you a word and you have to look very carefully at that word. After that, I will remove the word and you will have to write it down'. The visual dictation consisted of four main steps: 1) the word was named and shown to the students for three seconds, 2) the word was removed, 3) the word was repeated and the students had to write it down, 4) the word was shown again and the students had to check whether they had written it correctly. When it was written incorrectly, the students had to correct themselves. The experimenter also checked whether all students had written the word correctly.

Explicit training. During the six explicit training sessions, the morphological spelling rule for words with a final -D or -T was taught. The explicit training started with an explanation of the purpose of the training: 'Today we are going to do a special dictation. We will learn words that have to be written differently than that they are heard. I will teach you how to write those words'. After that, the rule was taught to the students. First, they were taught the function of the rule, by explaining that the rule could be applied to spell words with a final /t/-sound correctly ('Do you hear a /t/-sound at the end of the word?). Thereafter, the rule was taught to the students ('Convert the word to the plural form, so you can hear whether a T or a D has to be written.'). After the instruction of the rule, the rule was applied to two practice words, first to the word ZWAARD [sword] and thereafter to the word PET [cap], before the rule was applied to trained words. The training consisted of four main steps: 1) the word was named, 2) the rule was applied, 3) the students had to write down the word, 4) the word was shown and the students had to check whether they had written it correctly. When it was written incorrectly, the students had to correct their spelling. The experimenter also checked whether

Table 2 Statistics on the Reading and Spelling Tests and the Pretest for the Morphological Rule in the Experimental and Control Conditions

Condition	Word reading 1	Word reading 2	General word spelling	Pretest morphological rule	
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*Minimum -Maximum*
Implicit	30.5 (16.4)	17.8 (13.6)	18.6 (3.9)	.55 (.11)	.25-.83
Explicit	28.7 (17.8)	17.8 (15.1)	18.5 (3.9)	.54 (.09)	.33-.89
Control	32.5 (17.2)	17.7 (14.7)	18.5 (4.2)	.54 (.11)	.05-.85

all students had spelled the word correctly. If a student had not spelled the word correctly, the rule was repeated for that particular student.

Implicit and explicit training. For both the implicit and explicit training sessions, words were presented visually. The font used in most educational methods is Helvetica neue, which is unavailable for private people. The most closely related letter is Helvetica; a letter that is also sans serif. However, the 'a' and the 'aa' are different in Helvetica from the letter used in educational methods. Therefore, we used lowercase letters of Helvetica for all graphemes, except for the 'a' and the 'aa'; for those graphemes, we used lowercase letters of Comic Sans MS font (i.e., 'ɑ' and 'ɑɑ'). All words were printed on paper (A4-format) and each stimulus had its own page. During the training, the trainer presented each word visually on an A4-page to the entire group. To make sure that all students were able to view the word, font size 200 had to be used.

Both the implicit and the explicit training consisted of six sessions that took about 30 - 45 minutes. Our main goal was to compare the effects of implicit and explicit instruction, and not to provide an extensive training. Therefore, we had chosen to provide students with a relatively short training, to examine whether there are already effects visible after only a short training. We had to use six sessions because students had to become able to understand and apply the spelling rule, and this is not possible after only one or two sessions. In each session, all words from one set were trained twice (i.e., 10 target words and 5 fillers). In the next session, all 15 words of the other set were trained twice. Thus, for each group of students, two sets contained trained words and one set contained transfer words that were not trained. During each session of the implicit and the explicit training, first the procedure for the implicit and explicit conditions was practiced with the words ZWAARD [sword] and PET [cap].

Results

Two different analyses were performed. In the first analysis, we examined the differences in progress between students in the implicit, explicit, and control condition. In the second analysis, we investigated generalization of the rule, by testing for transfer effects. Spelling level was taken into account in both analyses.

The scores we used were the proportions of words in which the final -D or -T was written correctly. Initially, we intended to perform all analyses for both the morphological and phonological rule with raw scores. However, we were only able to match the implicit and explicit conditions on basis of their scores on the morphological pretest. Unfortunately, the scores on the pretest for the phonological rule differed significantly; on new words, the control condition scored lower than the implicit condition ($F(2, 190) = 5.67$, $p = .004$). Because we wanted to use the same procedures for both the morphological and the phonological rule, we chose to use difference scores as an indicator for change in performance of the students between pretest and posttest. Bonferroni corrections were applied to all analyses. Greenhouse-Geisser corrections were applied when the assumption of sphericity was violated.

Implicit, Explicit, and Control Condition

To examine the differences in progress between pretest and posttest for students in the implicit instruction, explicit instruction, and control condition, an ANOVA for repeated measures was conducted in a 2 (speller: low-skill vs. high-skill) x 3 (condition: implicit vs. explicit vs. control) x 2 (word type: new words vs. pseudowords) on the difference between pretest and posttest. Speller and condition were treated as between-subjects variables, and word type was treated as a within-subjects variable. It was not possible to include trained words in this analysis, because in the control condition, trained words could not be considered as 'trained' words, as there was no training. The mean scores of the three conditions are presented in Table 3.

The results of this analysis revealed that neither the three-way interaction between speller, condition, and word type ($F(2, 187) = .70$, $p = .50$), nor the two-way interactions between speller and word type ($F(1, 187) = 3.43$, $p = .07$), condition and word type ($F(2, 189) = 1.08$, $p = .34$), and speller and condition ($F(2, 187) = 1.46$, $p = .23$) reached significance. Thus, all main effects can be interpreted without further qualification.

The main effect of speller was not significant ($F(1, 187) = 1.00$, $p = .32$). Progress between pretest and posttest was the same for low- and high-skilled spellers. The main effect of condition was significant ($F(2, 187) = 3.48$, $p = .03$, *partial* $\eta^2 = .04$). Subsequent post-hoc *t* tests revealed that students in the explicit condition made

Table 3 Means and Standard Deviations on the Morphological Stimuli in the Experimental and Control Conditions

	Low-skilled speller			High-skilled speller		
	Implicit	*Explicit*	*Control*	*Implicit*	*Explicit*	*Control*
Pretest						
Trained	.48 (.10)	.47 (.10)		.59 (.14)	.58 (.13)	
New	.49 (.06)	.49 (.07)	.46 (.12)	.58 (.14)	.57 (.12)	.58 (.11)
Pseudo	.45 (.08)	.47 (.08)	.44 (.14)	.51 (.07)	.51 (.08)	.51 (.10)
Posttest						
Trained	.66 (.12)	.65 (.16)		.85 (.15)	.81 (.15)	
New	.58 (.11)	.55 (.14)	.52 (.08)	.72 (.16)	.74 (.17)	.62 (.12)
Pseudo	.49 (.09)	.54 (.17)	.47 (.10)	.53 (.15)	.59 (.14)	.52 (.10)

more progress than students in the control condition (p = .03), whereas no differences in progress emerged between students in the implicit and control condition (p = .35), or between students in the implicit and explicit condition (p = .92). The main effect of word type was also significant (F(1, 187) = 10.07, p = .002, *partial* η^2 = .05), indicating that students made more progress on new words than on pseudowords. The results are summarized in Table 4. Additional t tests showed that students in all three conditions made progress between pretest and posttest (i.e. implicit instruction, t(62) = -5.88, p < .0001, explicit instruction, t(70) = -7.32, p < .0001, and control condition, t(58) = -2.25, p = .03).

Table 4 Significant Effects of the Overall Analysis on Words with the Morphological Rule

Significant effect	*F*	*p*	η_p^2
Condition	F(2, 187) = 3.48	.03	.04
Explicit condition > control condition		.03	
Word type	F(1, 187) = 10.07	.002	.05
New words > pseudowords		.002	

Generalization[3]

To examine whether students in the experimental conditions generalized their knowledge a 2 (speller: low-skill vs. high-skill) x 2 (condition: implicit vs. explicit) x 3 (word type: trained vs. new vs. pseudowords) ANOVA with repeated measures was conducted on the scores on the posttest. Note that, to test for transfer, the raw scores on trained, new, and pseudowords have to be compared. Therefore, for this analysis, the scores on the posttest were used rather than the progress between pretest and posttest. Speller and condition were treated as between-subjects variables, and word type was treated as a within-subjects variable. The mean scores of the two conditions on the posttest are also presented in Table 3.

The results of this analysis revealed that neither the three-way interaction between speller, condition, and word type, ($F(2, 260) = .56$, $p = .57$), nor the two-way interaction between speller and condition ($F(1, 130) = .10$, $p = .76$), and the main effect of condition ($F(1, 130) = .10$, $p = .76$), reached a significant level. The main effects of speller ($F(1, 130) = 32.01$, $p < .0001$, *partial* $\eta^2 = .20$) and word type ($F(1.84, 238.93) = 86.19$, $p < .0001$, *partial* $\eta^2 = .40$) were significant, but these effects warranted further qualification because of two significant two-way interactions.

The significant two-way interaction between condition and word type ($F(2, 260) = 3.76$, $p = .03$, *partial* $\eta^2 = .03$) required analyses of the differences between the three word types for each condition separately.

ANOVA's on word type were conducted for the two experimental conditions separately. The effect of word type in the implicit condition was significant ($F(1.70, 105.34) = 82.25$, $p < .0001$, *partial* $\eta^2 = .57$). Post-hoc *t* test showed that students scored higher on trained words than on new and pseudowords and higher on new words than on pseudowords (all *p*'s < .0001). The effect of word type for students in the explicit condition was also significant ($F(2, 140) = 49.62$, $p < .0001$, *partial* $\eta^2 = .42$). Post-hoc *t* test revealed that students scored higher on trained words than on new and pseudowords, and higher on new words than on pseudowords (all *p*'s < .0001). Because the differences between word types were the same for both conditions, we were not yet able to explain the interaction effect. Therefore, we took a second step in which we analyzed this interaction further by comparing the scores of the two conditions for each word type separately.

3 With respect to generalization, we also did additional analyses in which we compared transfer effects of the experimental conditions with the control condition. For words with the morphological rule, students in the implicit and explicit condition scored higher on new words on the posttest than students in the control condition. Students in the explicit condition scored higher on pseudowords than students in the implicit and control condition. This means, although there is no full generalization, there is some level of generalization for students in the experimental conditions, and the explicit condition is slightly more effective for generalization than the implicit condition.

The one-way ANOVA analyses revealed non-significant differences between the explicit and the implicit condition for trained ($F(1, 132) = 1.56$, $p = .21$) and for new words ($F(1, 132) = .03$, $p = .86$). For pseudowords, however, students in the explicit condition scored significantly higher than students in the implicit condition ($F(1, 132) = 5.30$, $p = .02$, *partial* $\eta^2 = .04$). The differential effects of the two conditions on pseudowords explained the two-way interaction effect.

The two-way interaction between speller and word type was also significant ($F(2, 260) = 11.06$, $p < .0001$, *partial* $\eta^2 = .08$). We examined this interaction further by analyzing the differences between the three word types for low- and high-skilled spellers separately. ANOVA's indicated that for low-skilled spellers, the effect of word type was significant ($F(2, 72) = 16.11$, $p < .0001$, *partial* $\eta^2 = .31$). Post-hoc *t* test showed that low-skilled spellers scored higher on trained words than on new ($p < .001$) and pseudowords ($p < .0001$). No differences exist between new and pseudowords ($p = .25$). For high-skilled spellers, the effect of word type was also significant ($F(2, 192) = 125.15$, $p < .0001$, *partial* $\eta^2 = .57$). Post-hoc *t* test revealed that

Table 5 Significant Effects of the Generalization Analysis on Words with the Morphological Rule

Significant effect	*F*	*p*	η_p^2
Condition x word type	$F(2, 260) = 3.76$	.03	.03
Implicit condition	$F(1.70, 105.34) = 82.25$	< .0001	.57
Trained words > new words		< .0001	
Trained words > pseudowords		< .0001	
New words > pseudowords		< .0001	
Explicit condition	$F(2, 140) = 49.62$	< .0001	.42
Trained words > new words		< .0001	
Trained words > pseudowords		< .0001	
New words > pseudowords		< .0001	
Pseudowords	$F(1, 132) = 5.30$	.02	.04
Explicit > implicit		.02	
Speller x word type	$F(2, 260) = 11.06$	< .0001	.08
Low-skilled spellers	$F(2, 72) = 16.11$	< .0001	.31
Trained words > new words		< .001	
Trained words > pseudowords		< .0001	
High-skilled spellers	$F(2, 192) = 125.15$	< .0001	.57
Trained words > new words		< .0001	
Trained words > pseudowords		< .0001	
New words > pseudowords		< .0001	

high-skilled spellers scored higher on trained words than on new and pseudowords, and higher on new words than on pseudowords (all *p*'s < .0001). The results are summarized in Table 5.

Summary of Experiment 1 Results

The results showed that students in the explicit condition made more progress than students in the control condition. No differences in progress were found between students in the implicit and explicit condition, and implicit and control condition. The differences between the conditions were the same for low- and high-skilled spellers. Moreover, both low- and high-skilled spellers made the same amount of progress between pretest and posttest. With respect to the effect of word type, students made more progress on new words than on pseudowords in all three conditions, which was the same for low- and high-skilled spellers.

Neither the students in the explicit nor the ones in the implicit condition fully generalized their knowledge of the rule to new and pseudowords, because their scores on trained words were higher than on new words and pseudowords. This transfer decrement indicates that the students acquired rule-like knowledge rather than rule-based knowledge. Both low- and high-skilled spellers scored higher on trained words than on new and pseudowords. However, high-skilled spellers also scored higher on new words than on pseudowords, whereas for low-skilled spellers there were no differences between new and pseudowords. Note however, that while the posttest scores on trained and new words were the same for students in the implicit and explicit condition, students in the explicit condition scored higher on pseudowords than students in the implicit condition.

Experiment 2: The Phonological Rule

To apply a phonological rule, the speller needs knowledge of how phonemes are related to graphemes to produce the correct spelling (Steffler, 2001). In the Dutch language, the I in AAI, OOI, and OEI is pronounced as a /j/. The rule that was taught to the students was 'Do you hear /ɑɑj/, /ooj/, or /oej/ in a word? You hear the /j/, but you have to write an I'.

Method

Participants

The students who participated in Experiment 1 also took part in Experiment 2. Students in the explicit condition of Experiment 1 were also assigned to the explicit condition in Experiment 2. The same holds for assignment to the implicit and the control conditions. Due to organizational issues, however, four students who were in the explicit condition in Experiment 1 were assigned to the implicit condition in Experiment 2 and six students who were in the implicit condition in Experiment 1 were assigned to the explicit condition in Experiment 2. The scores on the first ($F(2, 190) = .73$, $p = .48$) and second ($F(2, 190) = .09$, $p = .91$) word reading test, the general word spelling test ($F(2, 190) = .003$, $p = 1.00$), and the pretest for spelling words containing the morphological rule ($F(2, 190) = .19$, $p = .83$) of the final sample of students in the implicit, explicit, and control conditions did not differ significantly. However, the scores on the pretest for the phonological rule differed significantly: Students in the control condition scored significantly lower on new words than students in the implicit condition ($F(2, 190) = 5.67$, $p = .003$). No differences between the conditions were found on words that would be trained ($F(1, 132) = .29$, $p = .59$) and on pseudowords ($F(2, 190) = 1.01$, $p = .37$). As explained in the Results' section of Experiment 1, this was the reason that difference scores rather than mean scores were used. Table 6 presents the number of students in each condition for the phonological rule and the mean age in months at the start of the study.

Table 6 Number of Students and Mean Age in the Experimental and Control Conditions for the Phonological Rule

		N		Age (months)
Condition		*Boys*	*Girls*	*M (SD)*
Implicit	*low-skilled speller*	10	6	83.8 (4.5)
	high-skilled speller	22	23	82.8 (4.8)
Explicit	*low-skilled speller*	10	11	83.7 (7.7)
	high-skilled speller	28	24	83.7 (4.5)
Control	*low-skilled speller*	9	6	84.3 (3.6)
	high-skilled speller	20	24	82.9 (3.6)

Materials

Test materials

The tests for word reading and general word spelling were described in the 'Materials section' of Experiment 1.

Spelling test for a phonological rule. The spelling skill on words containing a phonological rule was measured by a spelling-to-dictation task. Each student had to write down all 54 stimuli: 39 extant words and 15 pseudowords (see Appendix B). Details about the words are described in the paragraph below, because the words were also used for the training. Additionally, the test contained 10 pseudowords with -AAI, -OOI, or -OEI in final position, and 5 pseudowords with -AAI-, -OOI-, or -OEI- in medial position. The pseudowords with -AAI, -OOI, or -OEI in final position were monosyllabic. The pseudowords with -AAI-, -OOI-, or -OEI- in medial position were mono- or disyllabic. All pseudowords consisted of, except for the -AAI, -OOI, and -OEI-parts, consistent phoneme-to-grapheme relations. The pseudowords with -AAI, -OOI, or -OEI in final position, had a CVV, CCVV, or CCCVV-structure, and the pseudowords with -AAI-, -OOI-, or -OEI- in medial position had a CVVC, CCVVV, CCVVVC, or CCVVCV-structure. The vowel could be a single vowel or a double vowel. Because of the number of words, both the pretest and posttest were split into two sessions of 27 words. During the tests, all words were presented in a sentence context. Again, both spelling-to-dictation tests contained the same words in the same sentences, but the order of the sentences differed between the tests. The score for the phonological rule was the proportion of words in which the I or J was written correctly. Note that, the correctness of the response depended only on the target grapheme, errors in the remainder of the word were ignored. The procedure and instruction of the spelling-to-dictation tests was the same for Experiment 1 as for Experiment 2. The lowest possible score was zero and the highest was 54. The scores were converted into proportions.

Experimental materials

Phonological rule. The words that were used for the spelling training for words containing the phonological rule were 39 extant words: 10 words with -AAI, -OOI, or -OEI in final position, 5 words with -AAI-, -OOI-, or -OEI- in medial position, 15 words with a J, and 9 filler words. All words, except the words with J, and the words and pseudowords with -AAI-, -OOI-, or -OEI- in medial position, were monosyllabic, and had, except for the -AAI, -OOI, and -OEI-parts and except for the schwa-sounds in words with J and words with -AAI-, -OOI-, or -OEI- in medial position, consistent phoneme-to-grapheme relations. The words with -AAI, -OOI, or -OEI in final position had a CVV or CCVV-structure, and the fillers had a CVC or CCVC-structure. The words with -AAI-, -OOI-, or -OEI- in medial position had a CVVC, CCVVCV, CVVV, CCVVVC, or CVVVC-structure. The words with a J had a CVC, CVCC, CCVC,

VCCV, CVCCV, CVCCVC, VCCVC, or CVCCVC-structure. The vowel could be a single vowel or a double vowel. Because there are not enough monosyllabic words with the J in another position than the first grapheme, we also had to use disyllable words. Unfortunately, there were not enough words containing this category in the 'Streeflijst woordenschat voor zesjarigen' (Schaerlaekens et al., 1999 [List of words that the vocabulary of six-year olds intended to contain]). Because the phonological rule does not require additional information about the word, knowing the meaning of the words was not important to apply the rule correctly. Appendix B presents the stimuli used in this study.

The stimuli were divided into three sets. Set A and B consisted of stimuli that contained words drawn from each category (i.e., -AAI, -OOI, -OEI, (-)J-, filler) and structure. Set C consisted of words with -AAI-, -OOI-, and -OEI- in medial position. For each condition, two sets of words were used as trained words and the other set as transfer words. Again, the pseudowords were also used as transfer words, and thus not trained. As for the morphological rule, for the training sessions the words were printed on paper (A4-format) and each stimulus had its own page.

Procedure

The procedure was the same as for Experiment 1. The week after the posttest of the morphological rule, the pretest for spelling words containing the phonological rule was performed. A week after the pretest, the phonological training started, consisting of six sessions, divided over two weeks. In each training session, all words from one set were trained twice (i.e., 10 target words and 3 fillers). In the next session, all 13 words of the other set were trained twice. For each session of the implicit and explicit training, the word WAAI [blow] was used as a practice trail. The week after the training, the posttest was performed.

Matching. Table 7 presents the scores on the general tests for word reading and spelling, and on the pretest for words containing the phonological rule. As described in the participant section, students were matched based on the scores on

Table 7 Statistics on the Reading and Spelling Tests and the Pretest for the Phonological Rule in the Experimental and Control Conditions

	General word reading 1	General word reading 2	General word spelling	Pretest phonological rule	
Condition	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*Minimum - Maximum*
Implicit	30.4 (16.4)	17.2 (13.1)	18.6 (3.9)	.46 (.25)	.00-.96
Explicit	28.9 (17.7)	18.3 (15.4)	18.5 (3.9)	.42 (.25)	.13-1.00
Control	32.5 (17.2)	17.7 (14.7)	18.5 (4.2)	.37 (.23)	.00-.96

the tests for word reading and spelling, and on the pretest for words containing the morphological rule. The students were assigned to the same condition as in Experiment 1, however, as mentioned before, due to organizational issues, four students had to move from the explicit condition in Experiment 1 to the implicit condition in Experiment 2 and six students had to move from the implicit to the explicit condition (i.e., implicit vs. explicit; School 1: 9 vs. 9; School 2 Class 1: 9 vs. 15, Class 2: 5 vs. 5; School 3: 9 vs. 9; School 4 Class 1: 5 vs. 0, Class 2: 6 vs. 0, Class 3: 0 vs. 8, Class 4: 0 vs. 7; School 5: 9 vs. 11; School 6: 9 vs. 9).

Implicit training. The procedure for the implicit training was the same as for Experiment 1.

Explicit training. During the six explicit training sessions, the phonological spelling rule for words with AAI, OOI, or OEI was taught. Again, first the purpose of the training was explained by telling the students that they would be taught how to write words that have to be written differently than they are heard. Thereafter, the function of the rule was taught, by explaining that the rule could be applied to write words that contain an /ɑɑj/-, /oːj/-, or /oej/-sound correctly. After the instruction, the rule was applied to the practice word WAAI [blow], before the rule was applied to trained words. The explicit training was the same as for Experiment 1.

Results

Two different analyses were performed. In the first analysis, we examined the differences in progress between students in the implicit, explicit, and control condition. In the second analysis, we investigated generalization of the rule, by testing for transfer effects. Spelling level was taken into account in both analyses. The scores we used were the proportions of words in which the I or J was written correctly. Again, because of the differences on the pretest, we used difference scores as an indicator for change in performance of the students between pretest and posttest. Bonferroni corrections were applied to all analyses.

Implicit, Explicit, and Control Condition

To examine the differences in progress between pretest and posttest for students in the implicit instruction, explicit instruction, and control condition, an ANOVA for repeated measures was conducted, in a 2 (speller: low-skill vs. high-skill) x 3 (condition: implicit vs. explicit vs. control) x 2 (word type: new words vs. pseudowords) on the difference between pretest and posttest. Speller and condition were treated as between-subjects variables, and word type was treated as a within-subjects variable. It was not possible to include trained words in this analysis,

because in the control condition, trained words could not be considered as 'trained', as there was no training. The mean scores of the three conditions are presented in Table 8.

Table 8 Means and Standard Deviations on the Phonological Stimuli in the Experimental and Control Conditions

	Low-skilled speller			High-skilled speller		
	Implicit	*Explicit*	*Control*	*Implicit*	*Explicit*	*Control*
Pretest						
Trained	.37 (.21)	.33 (.13)		.55 (.21)	.54 (.25)	
New	.42 (.26)	.40 (.14)	.32 (.18)	.62 (.20)	.58 (.23)	.47 (.20)
Pseudo	.20 (.37)	.09 (.23)	.07 (.18)	.32 (.41)	.28 (.37)	.25 (.33)
Posttest						
Trained	.66 (.20)	.61 (.19)		.87 (.16)	.93 (.11)	
New	.54 (.20)	.56 (.25)	.37 (.21)	.78 (.19)	.81 (.23)	.67 (.23)
Pseudo	.39 (.37)	.37 (.35)	.19 (.35)	.70 (.30)	.80 (.25)	.48 (.42)

The results of this analysis revealed that neither the three-way interaction between speller, condition, and word type ($F(2, 187) = 1.52$, $p = .22$), nor the two-way interactions between speller and word type ($F(1, 187) = 3.15$, $p = .08$), speller and condition ($F(2, 187) = .12$, $p = .89$), and condition and word type ($F(2, 187) = 2.74$, $p = .07$) reached significance. However, the main effect of speller was significant ($F(1, 187) = 11.95$, $p = .001$, *partial* $\eta^2 = .06$), indicating that high-skilled spellers made more progress between pretest and posttest than low-skilled spellers. The main effect of condition was also significant ($F(2, 187) = 4.69$, $p = .01$, *partial* $\eta^2 = .05$). Post-hoc *t* test revealed that students in the explicit condition made more progress than students in the control condition ($p = .01$). No differences emerged between students in the implicit and explicit condition ($p = .26$), and between students in the implicit and control condition ($p = .63$). The main effect of word type was also significant ($F(1, 187) = 24.74$, $p < .0001$, *partial* $\eta^2 = .12$), indicating that students made more progress on pseudowords than on new words. The results are summarized in Table 9. Additional *t* tests showed that students in all three conditions made progress between pretest and posttest (i.e. implicit instruction, $t(60) = -9.72$, $p < .0001$, explicit instruction, $t(72) = -12.15$, $p < .0001$, control condition, $t(58) = -5.92$, $p < .0001$).

Table 9 Significant Effects of the Overall Analysis on Words with the Phonological Rule

Significant effect	*F*	*p*	η_p^2
Speller	*F*(1, 187) = 11.95	.001	.06
High-skilled spellers > low-skilled spellers		.001	
Condition	*F*(2, 187) = 4.69	.01	.05
Explicit condition > control condition		.01	
Word type	*F*(1, 187) = 24.74	< .0001	.12
Pseudowords > new words		< .0001	

Generalization[4]

To examine whether students in the experimental conditions generalized their knowledge, a 2 (speller: low-skill vs. high-skill) x 2 (condition: implicit vs. explicit) x 3 (word type: trained vs. new vs. pseudowords) ANOVA with repeated measures was conducted on the scores at the posttest. Similar to Experiment 1, the scores on the posttest were used rather than the progress between pretest and posttest. Speller and condition were treated as between-subjects variables, and word type was treated as a within-subjects variable. The mean scores of the two conditions on the posttest are also presented in Table 8.

The results of the analysis revealed that neither the three-way interaction between speller, condition, and word type ($F(2, 260) = .73$, $p = .48$), nor the two-way interactions between condition and word type ($F(2, 260) = .25$, $p = .78$), and speller and condition ($F(1, 130) = 1.27$, $p = .26$), and the main effect of condition ($F(1, 130) = .31$, $p = .58$) reached a significant level. The main effects of speller ($F(1, 130) = 67.62$, $p < .0001$, *partial* $\eta^2 = .34$) and word type ($F(2, 260) = 38.32$, $p < .0001$, *partial* $\eta^2 = .23$) were significant, but these effects warranted further qualification because of the significant two-way interaction between speller and word type ($F(2, 260) = 3.96$, $p = .02$, *partial* $\eta^2 = .03$). We examined this interaction further by analyzing the difference between the three word types for low- and high-skilled spellers separately.

ANOVA's on word type were conducted for low- and high-skilled spellers separately. For low-skilled spellers, the effect of word type was significant ($F(2, 72) = 16.36$, $p < .0001$, *partial* $\eta^2 = .31$). Post-hoc *t* test showed that low-skilled spellers scored

4 With respect to generalization, we also did additional analyses in which we compared transfer effects of the experimental conditions with the control condition. For words with the phonological rule, students in the implicit and explicit condition scored higher on new and pseudowords on the posttest than students in the control condition. This means, although there is no full generalization, there is some level of generalization for students in the experimental conditions.

higher on trained ($p < .0001$) and new words ($p = .01$) than on pseudowords. No differences exist between new and trained words ($p = .10$). For high-skilled spellers, the effect of word type was also significant ($F(2, 192) = 23.37$, $p < .0001$, *partial* $\eta^2 = .20$). Post-hoc *t* test revealed that high-skilled spellers scored higher on trained words than on new ($p < .0001$) and pseudowords ($p < .0001$). No difference exists between new and pseudowords ($p = .19$). The results are summarized in Table 10.

Table 10 Significant Effects of the Generalization Analysis on Words with the Phonological Rule

Significant effect	*F*	*p*	η_p^2
Speller x word type	$F(2, 260) = 3.96$	.02	.03
Low-skilled spellers	$F(2, 72) = 16.36$	< .0001	.31
Trained words > pseudowords		< .0001	
New words > pseudowords		.01	
High-skilled spellers	$F(2, 192) = 23.37$	< .0001	.20
Trained words > new words		< .0001	
Trained words > pseudowords		< .0001	

Summary of Experiment 2 Results

The results showed that students in the explicit condition made more progress than students in the control condition. No differences in progress exist between students in the explicit and implicit, and implicit and control condition. The differences between the training conditions were the same for low- and high-skilled spellers, however, high-skilled spellers made more progress between pretest and posttest than low-skilled spellers. With respect to the effect of word type, students made more progress on pseudowords than on new words in all three conditions.

With respect to generalization, both students in the implicit and explicit condition did not completely generalize their knowledge to new and pseudowords. For both conditions there was a transfer decrement, indicating that students in both conditions acquired rule-like knowledge rather than rule-based knowledge. Low-skilled spellers scored higher on trained and new words than on pseudowords, whereas high-skilled spellers scored higher on trained words than on new and pseudowords. Thus, for low-skilled spellers, the scores on new words did not differ from the scores on trained words. For high-skilled spellers, the scores on new words did not differ from the scores on pseudowords.

General Discussion

The present study examined the effect of implicit and explicit instruction of a morphological and a phonological spelling rule for Dutch first grade students. We first examined the differences in progress between students in the implicit, explicit, and control condition. Thereafter, we tested for generalization of the rule, by investigating transfer effects, and examining whether students acquire rule-based or rule-like knowledge as a result of the implicit or explicit training. Regarding both questions, we also took into account the influence of spelling level, to examine whether the results were different for low- and high-skilled spellers, and the influence of word type, to examine whether the results were different for trained words, new words, and for pseudowords. These questions will be answered successively.

Implicit, Explicit, and Control Condition

With respect to the difference in progress between students in the implicit, explicit, and control condition, the results indicated that for both the morphological and phonological rule, students in the explicit condition made more progress than students in the control condition. Kemper et al. (2012) also concluded that explicit instruction was more effective than implicit instruction for a morphological rule. However, their effect was slightly stronger than our effect. A possible explanation for the smaller effect of the explicit condition in our study, is that students had difficulties converting a word with the morphological rule into its plural form. For instance, they said 'EEN HERT' [one deer], 'TWEE HER*D*EN' rather than 'TWEE HER*T*EN' [two deer]. To be able to write words with the morphological rule correctly, students have to know the correct plural form of these words. In our study, some students converted words into an incorrect plural form, and consequently, spelled these words incorrectly. Neijt and Schreuder (2007) found that spellers have a preference for the writing of D's over T's. Although they assessed this for D's and T's in medial positions, in contrast to final positions in our study, their findings might be related to ours. In Kemper et al.'s study, the plural form of the words was already visible on the assignment, both in the implicit and explicit condition, so it was not possible for students to convert a word into an incorrect plural form. Moreover, in our study we used a rather effective approach in our implicit condition, that is visual dictation. Because visual dictation is so effective for both poor and good spellers (e.g., van Hell et al., 2003; van Leerdam et al., 1998), the difference between implicit (i.e., visual dictation) and explicit instruction may be smaller in our study than in the study of Kemper et al.

With respect to spelling level, the results showed that, both for the morphological and phonological rule, the effects of the conditions were the same

for low- and high-skilled spellers. Moreover, for the morphological rule, both low- and high-skilled spellers made the same amount of progress between pretest and posttest. For the phonological rule, high-skilled spellers made more progress between pretest and posttest than low-skilled spellers. To sum up, apart from the fact that high-skilled spellers did better than low-skilled spellers, no differences in instruction method emerged between low- and high-skilled spellers. This is in line with a previous Dutch study by Hilte and Reitsma (2011), in which there were no differences in effects of the implicit and explicit condition for low-skilled and for high-skilled spellers either for an orthographic rule.

With respect to the effect of word type on words with the morphological rule, students made more progress on new words than on pseudowords, whereas on words with the phonological rule, they made more progress on pseudowords than on new words. An explanation for this contradiction may be that the phonological rule may be easier to detect during both the implicit and explicit training, and consequently, was also easier to apply to pseudowords. To apply the phonological rule, students only have to know that the /j/-sound has to be written as an I in /ɑɑj/, /ooj/, and /oej/. This rule might be easier to detect than the morphological rule that requires students to use multiple steps. First, the target word has to be transposed into its plural form. For this step, students not only have to know how to transpose a word in a plural form, they also have to know the correct plural form of the word. Secondly, they have to detect a /t/- or /d/-sound in the plural form and, consequently, write the target word with the T or D. The phonological rule is easier, because every /j/-sound has to be transposed in an I, whereas for the morphological rule, a /t/-sound can be transposed into both a T or a D. Moreover, it was harder for students to apply the morphological rule to pseudowords than to new words. Pseudowords with the morphological rule were presented as a plural in the sentence. To be able to apply this rule to pseudowords, students also had to listen to the sentence to detect the plural form of the pseudoword before they could apply the rule correctly. This extra step might have made it more complicated to spell pseudowords correctly than to spell new words correctly. In contrast, for words with the phonological rule, the rule could just be applied to pseudowords as it could be applied to new and trained words.

Another explanation for the differential effects of the morphological and phonological rule is that the pretest scores on pseudowords were much lower for the phonological rule than for the morphological rule. Consequently, students had more room for progress on pseudowords than on new words containing the phonological rule and on pseudowords containing the morphological rule. The lower pretest scores on pseudowords with the phonological rule may be caused by the fact that students wrote more often the J than the I, whereas on pseudowords with the morphological rule, students most often wrote T instead of D. However,

when students wrote the T on each occasion, they had a score of .50, because fifty percent of the words had to be written with a T and fifty percent with a D, whereas when students wrote all words with /ɑɑj/, /oːoj/, or /oːej/ with a J, they had a score of zero.

Thus, the differential effects between the two rules may come about because of the following issues, a) it is easier to detect the phonological rule than the morphological rule, b) it is easier to apply the phonological than the morphological rule to pseudowords, or c) there was more room for progress on pseudowords than on new words with the phonological rule and than on pseudowords with the morphological rule. For both rules, the difference in progress between new and pseudowords was equal for students in the three conditions and for low- and high-skilled spellers. To summarize, explicit instruction was most effective for both the morphological and phonological spelling rule and this was the same for high- and low-skilled spellers as well as for trained, new, and pseudowords.

Generalization

The second question was whether students in both the implicit and explicit condition generalized their knowledge of the rules to new and pseudowords. A transfer decrement occurred in the two experimental conditions and for both rules. With respect to the morphological rule, both students in the implicit and explicit condition scored higher on trained words than on new and pseudowords, and higher on new words than on pseudowords. There was an effect of spelling level; although both low- and high-skilled spellers scored higher on trained words than on new and pseudowords, high-skilled spellers also scored higher on new words than on pseudowords, whereas for low-skilled spellers the scores on new and pseudowords were equal. A possible explanation is that high-skilled spellers already knew more new words by heart than low-skilled spellers, without having to apply the rule. It is not possible for them to know pseudowords by heart.

Another explanation may be that they knew better how to apply the rule to new words than low-skilled spellers, but that it was too difficult for them to apply the rule to pseudowords, because of the extra step that has to be taken (i.e., detect the plural form in the sentence). Low-skilled spellers scored equally low on new and pseudowords. Note, however, that students in the explicit condition scored higher on pseudowords than students in the implicit condition, but not on new or trained words. This suggests that explicit instruction is possibly more effective for learning the plurals of words than implicit instruction, which may be explained by the way the pseudowords were dictated. Pseudowords were presented as a plural in the sentence. Students then had to write down the singular form. Students who received explicit instruction may indeed have become more sensitive to the plural form of the pseudoword as a result of training. The fact that this was not generalized to new and trained words, of which the plural was assumed to be known and thus

not presented in the dictation reveals that the explicit training was only successful when the test procedure mimicked the training procedure.

With respect to the phonological rule, there was also an effect of spelling level; low-skilled spellers had the same scores on new as on trained words and lower scores on pseudowords, whereas high-skilled spellers scored higher on trained words than on new and pseudowords. A possible explanation is the fact that the training was more effective for high-skilled spellers than for low-skilled spellers, which was also indicated by the results that were described above. Because low-skilled spellers learned less during the training, their difference between trained and new words was smaller than for high-skilled spellers who did learn more during training.

To sum up, students did not fully generalize their knowledge of the rule to new and pseudowords. For students in both conditions there was a transfer decrement, so it is assumed that, on average, students in both conditions acquired rule-like knowledge rather than rule-based knowledge. Our finding that students acquired rule-like knowledge rather than rule-based knowledge is in line with the results of Kemper et al. (2012) for the orthographic rule, and for low-skilled spellers for the morphological rule. Note, however, that the students in our study did not fully acquire the rule, because they did not reach the 100%-correct. The six training sessions for each rule were not enough for fully mastering the rule.

With respect to spelling level, the generalization effects were about the same for low- and high-skilled spellers, both groups did not fully generalize their knowledge of the rule to new and pseudowords. This is in line with the results of Hilte and Reitsma (2011), in which there were no differences in effect of the implicit and explicit condition for low-skilled and for high-skilled spellers either for a Dutch orthographic rule. This finding, however, is in contrast with another previous Dutch study by Kemper et al. (2012), in which differences were found between low- and high-skilled spellers for the same morphological rule as was used in our study. In their study, there was a transfer decrement for low-skilled spellers in both the implicit and explicit condition, but not for the high-skilled spellers in the explicit condition. The difference between our results and the results of Kemper et al. could be explained by the different selection criteria for low- and high-skilled spellers. In our study, only spellers from mainstream primary education participated and were divided into the lowest 27 and highest 73 percent. In the study of Kemper et al., the group of poor spellers consisted of students from special education, whereas the group of good spellers consisted of students from mainstream education. The difference in spelling ability between the two groups was larger in the study by Kemper et al. It might be that, in our study, the difference in spelling level between low- and high-skilled spellers was not large enough to find differences regarding effective spelling instruction.

To summarize, both implicit and explicit instruction did not induce full generalization of the spelling rules to new words. For the morphological rule, the explicit condition was more effective for the generalization to pseudowords than the implicit condition. The generalization effects were about the same for low- and high-skilled spellers.

Limitations of the Present Study

Our study has some limitations that could be used as guidelines for further research in this domain. The first limitation is the short duration of the training. For both the morphological and the phonological rule, the training consisted of only six sessions of 30 to 45 minutes. Six sessions was not enough for fully mastering the rule, since there was an absence of errorless learning. It would be interesting to examine the effects of a training consisting of more sessions over a longer period of time. Moreover, when a more extensive training will be used, the long-term effects of the training could also be investigated.

A second limitation may be that pretest scores on words containing a phonological rule were lower for students in the control condition than for students in the implicit condition. We solved this problem by using difference scores instead of means scores. It was not possible to match students based on their pretest scores on words containing a phonological rule, because moving students from one condition to another might have lead to unreliable training conditions. More specifically, when students who participated in the explicit condition in Experiment 1 were moved to the implicit condition in Experiment 2, they might be triggered to search for an underlying spelling rule, which would have affected the integrity of the implicit condition. It was also not possible to administer the pretest for the phonological rule at the same time as the pretest for the morphological rule. The time between testing and training would have been about two months.

The fact that students who participated in the implicit or explicit condition in Experiment 1 also participated in this same condition in Experiment 2 could have been a problem if the effects of the training in the first experiment transferred to the second experiment. The effects of Experiment 2, however, were not stronger than the effects of Experiment 1, which suggests that no benefits occurred from participating in Experiment 1 prior to Experiment 2.

A third limitation of the present study is that we did not check whether students in the implicit condition discovered the underlying spelling rule by themselves or heard the rule from students in the explicit condition. For further research, we recommend an interview with the participants to ensure that the students in the explicit condition did not tell students in the implicit condition about their training or about the rules that were taught, and to establish whether students in the implicit condition detected the rules by themselves.

Practical Implications

Our study indicates that students who received spelling training made more progress than students who did not receive extra spelling training, which is in accordance with previous research (Bosman, 2004). For clinical practice, this means that students have to receive consistent spelling training. Our results showed that students did not reach 100% correct, which means that only six training sessions for each rule were insufficient for students to fully acquire the rule. Moreover, our results showed that explicit instruction was most effective. For clinical practice, this means that teaching a rule is beneficial for students learning the spelling of that particular category. However, the effects are not very strong, so more research on explicit instruction is necessary. It is important to keep in mind all steps that are necessary to correctly apply the rule. For instance, in our study, students had to know the plural form of words to apply the morphological rule correctly. When a new rule is taught to students, these prerequisites need to be taken into account.

Moreover, our study indicated that the most effective instruction did not differ between low- and high-skilled spellers. This means that low-skilled spellers only need more instruction and more practice than high-skilled spellers, but not different instruction. Overall, our study suggests that using explicit instruction is an effective way to teach spelling and that the strength of the effect of the explicit training condition depends not on the spelling level of the students. However, more research on explicit spelling instruction is necessary, since the effects of this short training are not very strong. Our short training revealed that six sessions were not enough to generalize spelling knowledge to new words. More instruction and practice is needed to fully acquire the rules.

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Appendix A. Stimuli morphological rule[a]

final -d words	final -t words	filler words	pseudowords
hond [dog]	hert [deer]	muts [cap]	hift
hoed [hat]	voet [foot]	doek [cloth]	woet
bed [bed]	pit [pit]	pil [pill]	zwat
mond [mouth]	kast [closet]	kaars [candle]	kront
woord [word]	kaart [card]	fiets [bicycle]	daft
vriend [friend]	staart [tail]	dwerg [dwarf]	burd
bord [plate]	feest [party]	dans [dance]	zoerd
speld [pin]	kwast [brush]	storm [storm]	plond
hand [hand]	nest [nest]	dorp [village]	knood
baard [beard]	kist [box]	hals [neck]	sod
brood [bread]	friet [French fries]	draak [dragon]	
paard [horse]	vuist [fist]	heks [witch]	
draad [thread]	spuit [needle]	steen [stone]	
zaad [seed]	poot [leg]	teen [toe]	
hoofd [head]	punt [point]	berg [mountain]	

[a] Note that for each student, a part of the extant words was used as trained words and another part was used as new words to measure transfer effects. Pseudowords were also used to measure transfer effects.

Appendix B. Stimuli phonological rule[b]

final -i	medial -i-	j	fillers	pseudo -i	pseudo -i-
haai [shark]	naait [sews]	juf [teacher]	vlieg [fly]	faai	knaaien
maai [mow]	draaide [turned]	jas [coat]	trap [stairs]	plaai	vaait
kraai [crow]	mooie [beautiful]	jeuk [itch]	stoel [chair]	straai	frooide
hooi [hay]	prooien [preys]	jurk [dress]	pen [pen]	wooi	soeit
gooi [trow]	boeien [chains]	sjaal [scarf]	mug [gnat]	grooi	kroeie
plooi [fold]		sjok [trudge]	bes [berry]	sprooi	
doei [bye]		sjouw [dance]	muis [mouse]	zwooi	
roei [row]		sjoel [drag]	zeep [soap]	noei	
knoei [mess]		boekje [little book]	lijm [glue]	ploei	
groei [grow]		hutje [shed]		stroei	
		tasje [purse]			
		aapje [monkey]			
		kanjer [stunner]			
		anjer [carnation]			
		biljet [play bill]			

[b] Note that for each student, a part of the extant words was used as trained words and another part was used as new words to measure transfer effects. Pseudowords were also used to measure transfer effects.

Chapter 6

Improving spelling performance and spelling consciousness

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This chapter has been accepted pending revisions as:
Cordewener, K. A. H., Verhoeven, L., & Bosman, A. M. T. (2014).
Improving spelling performance and spelling consciousness.

Acknowledgment
We thank Charles A. Perfetti for his insightful contributions to this chapter.

Abstract

This study examined the immediate and sustained effects of three feedback conditions on both spelling performance and spelling consciousness of 72 third grade low- and high-skilled spellers. Spellers were assigned to a strategy-instruction, self-correction, or no-correction condition. The role of spelling ability and word characteristic were also taken into account. Regarding the immediate effects, the strategy-instruction condition was more effective for spelling performance, and more effective for spelling consciousness pertaining to loan words than the no-correction condition. Regarding the sustained effects on spelling performance and spelling consciousness, the positive effect of the strategy-instruction condition faded out after training. The four training sessions were insufficient for establishing long-lasting effects.

Improving Spelling Performance and Spelling Consciousness

When students are first learning to spell, they have to acquire the ability to segment words into phonemes and to connect phonemes to their corresponding graphemes. For words with consistent phoneme-to-grapheme relationships (e.g., STOP and STAR), this process is fairly easy. For words with inconsistent phoneme-to-grapheme relationships (e.g., CHEAP and CHOIR), however, this conversion process cannot be applied without additional knowledge of phonological, morphological, or orthographic rules. To be able to spell these inconsistent words correctly, awareness of the spelling rules and knowing when and how to apply them is required. Knowledge of one's spelling difficulties and the ability to detect and correct one's spelling errors is known as spelling consciousness (Block & Peskowitz, 1990; Bosman, 2004; Lull, 1917).

Spelling Consciousness

One way of assessing spelling consciousness is having spellers assess whether the spelling they produced is correct or incorrect. Various studies have shown that primary-school students are often unable to accurately evaluate their own spellings (Koning, 1985; McFarland, as cited in Lull, 1917; Tidyman, 1919). More specifically, students find it particularly hard to correctly indicate when they misspelled a word (Hendrikson & Pechstein, 1926; Tidyman, 1919). Students, however do not lack spelling consciousness altogether. An example is a Dutch study concerning a free writing assignment: Six-grade students mainly used words they knew how to spell (Jansen-Donderwinkel, Bosman, & van Hell, 2002). Moreover, even second-grade students ask their teachers about words they are not sure about (Gunderson, 1943). Nevertheless, large individual differences between students exist with respect to spelling consciousness (Hendrickson & Pechstein, 1926; Kreiner & Green, 2000).

Spelling consciousness and spelling performance are positively related (Block & Peskowitz, 1990; Hendrickson & Pechstein, 1926; Lull, 1917). Perhaps, improving spelling consciousness improves students spelling performance. Paffen and Bosman (2005) demonstrated that spelling consciousness can be improved by a training that consisted of five sessions only. Students in the experimental condition were first made aware of their spelling difficulties and were subsequently instructed to use meta-cognitive strategies. After the training, students in both the experimental and control group were better at evaluating the correctness of their own spelling, but students in the experimental group improved significantly more. The fact that the pretest (and the posttest) consisted of a large number of words to evaluate (i.e., 200), may have enhanced the students' awareness of their

spelling ability, and consequently had an effect on their judgements on the posttest. Thus, it appears that spelling consciousness can be improved using a short training aimed at using meta-cognitive strategies. Whether spelling consciousness can also be improved by adequate spelling instruction is not yet clear.

Spelling Instruction

A large number of studies have shown that adequate spelling performance requires formal spelling instruction (e.g., Bosman, 2004; Bosman & de Groot, 1992; Butyniec-Thomas & Woloshyn, 1997; Devonshire & Fluck, 2010; Faber, 2006; Fulk & Stormont-Spurgin, 1995; Gettinger, Bryant, & Fayne, 1982; Graham, 1999, 2000; Wanzek, Vaughn, Wexler, Swanson, Edmonds, & Kim, 2006), particularly for poor spellers (Gettinger et al., 1982; Graham, 1999, 2000).

Van Leerdam, Bosman, and Van Orden (1998) have shown that spelling instruction needs to be geared to the particular spelling difficulty of the word, because no one-size fits all approach exists. For example, learning the spelling of words with ambiguous phoneme-to-grapheme relationships is different from learning words with inconsistent phoneme-to-grapheme relationships. Words with ambiguous phoneme-to-grapheme relationships contain one or more phonemes that can be spelled multiple ways; for example, the /i˘/ in the English word CHEAP is an ambiguous phoneme, because there is also an alternative EE spelling as in KEEP. Words with inconsistent phoneme-to-grapheme relationships contain graphemes of which the pronunciation deviates from the prototypical one; for example, the English word PINT is pronounced differently from HINT, MINT and TINT. Words like, CHOIR and BOURGEOIS, also known as strange words, also belong to this category. Research has shown that the spelling of words with ambiguous phoneme-to-grapheme relationships are best taught by means of visual dictation (Bosman & van Hell, 1999; van Hell, Bosman, & Bartelings, 2003), whereas words with inconsistent phoneme-to-grapheme relationships are most effectively learned by overpronunciation or regularizing the spelling (Bosman, van Hell, & Verhoeven, 2006). Regularizing the spelling requires students to read the particular word aloud according to prototypical grapheme-to-phoneme relationships.

Strategy instruction

An important aspect that appears to enhance spelling performance, and, as a result the self-teaching skills of spellers, is to develop spelling strategies. Instruction of spelling rules (Butyniec-Thomas & Woloshyn, 1997; Kernaghan & Woloshyn, 1995; Paffen & Bosman, 2005), application of syllable segmentation (Butyniec-Thomas & Woloshyn, 1997), and visual imagery (Kernaghan & Woloshyn, 1995) are often part of a spelling-strategy training. Word spellings that obey rules require the explanation and practicing of the rule (Butyniec-Thomas & Woloshyn,

1997; Cordewener, Bosman, & Verhoeven, 2014; Darch, Eaves, Crowe, Simmons, & Conniff, 2006; Hilte & Reitsma, 2011; Kemper, Verhoeven, & Bosman, 2012). In Dutch, rules are determined by phonological, morphological, and/or orthographic principles. When students learn to use spelling rules, they are most likely to develop the ability to spell unfamiliar words that belong to that specific category. In the Paffen and Bosman (2005) training, students learned to use meta-cognitive strategies that entailed that they pronounced the word carefully, segmented it into syllables, and recalled the spelling rule that had to be applied to spell that syllable correctly. The training was highly effective for both poor and good readers/spellers.

Self-correction

In a self-correction procedure, students usually compare their spellings with a model; in case it is misspelled they write the correct spelling next to the incorrectly spelled word (Morton, Heward, & Alber, 1998). Self-correction is effective in students in general education (McGuffin, Martz, & Heron, 1997; Wirtz, Gardner, Weber, & Bullara, 1996), special education (Grskovic & Belfiore, 1996), and in students with learning disabilities (McNeish, Heron, & Okyere, 1992). Gettinger (1985) showed that spelling performance of poor spellers increased more when students had to find the errors themselves than when the teacher marked the errors. Block and Peskowitz (1990) showed that self-correction increased spelling consciousness. Students had to indicate prior to writing the word, whether they believed they were able to spell the word correctly. After they had written the word they were asked whether they thought they had written the word correctly or not. Visual inspection of the word, particularly when the word was also read aloud increased the accuracy with which students were able to indicate the correctness of their spellings. Thus, self-correction appears to improve spelling performance as well as spelling consciousness.

Spelling Ability and Word Characteristics

There is not yet consensus about the question of whether spelling instruction for poor spellers should be the same as for good spellers. Jansen-Donderwinkel et al. (2002) showed that the spelling consciousness of students from regular education was better than that of students from special education. Students from special education usually also have a lower spelling level than students from regular education. The inference that poor spellers may have a lower spelling consciousness than good spellers is corroborated by a study of Deshler, Ferrell, and Kass (1978). Interestingly, poor spellers are more confident about their spellings than good spellers and are consequently less inclined to check their spellings (see also Snow in Block & Peskowitz, 1990).

Two studies by Willemen, Bosman, and van Hell (2000, 2002) also provided evidence for the assumption that spelling consciousness and the strategies of poor spellers are dissimilar from those of good spellers. Spellers from both special and regular education took part in a self-correction training in which they were explicitly taught to use strategies for self-correction. Students in the control group did not receive instructions, but were simply asked to correct their work. Spelling performance of students in the training group increased more than that of those in the control group. Interestingly, spelling performance of students from regular education who participated in the control group also increased, whereas that of students in special education did not. This study showed that poor spellers are more dependent on spelling instruction than good spellers, but in the Paffen and Bosman study (2005), spelling consciousness of poor readers/spellers increased as much as that of good readers/spellers after training. To what extent poor spellers benefit as much from instruction in spelling and spelling strategies as good spellers is still unsettled. This study will, therefore, also address differential effects of spelling ability.

Another issue that will be investigated is the effect of word characteristics on spelling performance and spelling consciousness. The Dutch language contains native Dutch and non-native Dutch words. The spelling of native Dutch words is based on Dutch spelling rules, whereas non-native Dutch or loan words cannot be spelled according to Dutch spelling rules (Bosman, 2004). To accurately measure spelling consciousness, words that could be spelled correctly (native Dutch) as well as words that most probably could not be spelled correctly (loan words) have to be included in the study. Moreover, loan words are not included in the training; the strategy that is taught can only be applied to native Dutch words. Note, however, that some of the strategies can be applied to parts of the loan words. For these reasons, and because loan words are part of Dutch spelling education, it is interesting to examine whether students also make progress in both spelling consciousness and spelling performance on loan words.

Present Study

The main goal of this study is to answer the question which feedback is most effective for the improvement of both spelling performance and spelling consciousness? Three training conditions were developed for students in third grade: a strategy-instruction condition, a self-correction condition, and a no-correction condition.

The strategy-instruction condition aimed at teaching students a more or less integral spelling strategy that they can apply to different kinds of words. This strategy included dividing words into syllables and applying spelling rule(s). This strategy had to be applied by means of self-verbalization. By teaching students to divide words into syllables and apply spelling rules, we offered them a structured

way of thinking about each syllable of the word and we tried to encourage them to actively think about the way to correctly spell words during their spelling activities, which in turn should improve their spelling performance and spelling consciousness. The self-correction condition aimed at having students compare their spelling of words with a model and have them correct the misspelled words by writing the correct spelling next to the incorrectly spelled word. In the no-correction procedure, students did not receive their dictation sheet back; they received no additional practice.

Both immediate and sustained effects of the three feedback conditions were examined. Although the training was short (four sessions only) and sustained effects are unlikely to emerge, we nevertheless tested the students five weeks after the training had stopped.

Two additional questions were addressed, namely, whether the effect of the three conditions depend on spelling ability (low- vs. high-skilled spellers) and word characteristics (regularly-spelled vs. loan words). With respect to spelling consciousness, we investigated whether the changes in spelling consciousness were caused by changes in criteria rather than knowledge of the correct spelling by using Signal Detection Theory-measures (Macmillan & Creelman, 1991; Stanislaw & Todorov, 1999). Thus, we examined whether sensitivity and response bias changed between pretest, posttest, and retention test. Sensitivity is the proportion of 'yes'-responses written correctly. Response bias is the extent to which a speller might be more likely to respond 'yes' than 'no' or vice versa.

Method

Participants

In the present study participated 72 third-grade students (39 girls, 33 boys) between the ages of 95 and 122 months (M = 107.1, SD = 5.7). All students spoke Dutch at school. At home, one student spoke Serbian and one student spoke both Dutch and English. Students were recruited from four classes of two different primary schools. Both schools used the spelling method 'Taaljournaal' [Language News] (Horst, 1993). This is a method in which spelling rules are classified in different categories. Both schools used the same method ensuring that all students had learned the same spelling rules and that the rules were taught in the same way.

Based on a standardized spelling test (see Materials), students were divided, according to a median split, into low-skilled and high-skilled spellers. The fifty percent lowest-scoring students were classified as low-skilled spellers and the other spellers were classified as high-skilled spellers. Assignment to the three conditions was based on the score on the standardized spelling test, the spelling

score on the pretest, the spelling-consciousness score on the pretest, their age, and their sex. The matching procedure resulted in a distribution of the students in the three conditions that did not differ on standardized word spelling ($F(2, 64) = 1.75$, $p = .18$), scores on experimental spelling ($F(2, 69) = .85$, $p = .43$), scores on spelling consciousness ($F(2, 69) = .01$, $p = 1.00$), age ($F(2, 69) = .43$, $p = .65$), and sex ($F(2, 69) = .33$, $p = .72$).

Both schools had two Grade-3 classes. Students in the strategy-instruction and no-correction condition were from one class and students in the self-correction condition were from the other class.[1] Table 1 presents the number of boys and girls and their age for each of the three conditions. In our analyses, we only included students who took part in at least two of the four training sessions and missed not more than one third of the pretest, posttest or retention test.

Table 1 Number of Students and Mean Age in the Strategy-instruction, Self-correction, and No-correction Condition

		N		Age (months)
Condition		*Girls*	*Boys*	
Strategy-instruction				
	N	16	11	
	Mean			106.6
	SD			5.7
Self-correction				
	N	10	8	
	Mean			108.1
	SD			6.0
No-correction				
	N	13	14	
	Mean			106.9
	SD			5.7

Materials

Standardized spelling test

A standardized spelling-to-dictation test was used to assess spelling skill: 'Schaal Vorderingen in Spellingvaardigheid' [Scale Progression in Spelling Abilities] of

1 In the original design of this study, we had a fourth condition in which students received the same training as in the condition that is now named the 'strategy-instruction condition'. However, in this fourth condition, the training was not given individually, but to a group of students. Unfortunately, the Master students who trained the students, were not used to teaching a group of students. Despite the extensive instruction they received in how to train the students, it was hard for them to get the students paying attention during the training. Due to this lack of teaching experience, a large number of the third-grade students were hardly paying attention. Consequently, we decided not to include this condition into the analyses.

van den Bosch, Gillijns, Krom, and Moelands (1991). This test was used to obtain a general indication of the spelling level of the students and contained 36 disyllabic or tri-syllabic words at the Grade-3 level. In all dictation tasks, students had to write down the words that were orally presented to them. The lowest possible score was zero and the highest was 36. All scores were converted into percentages.

Words used in the pre-, post-, and retention test[2]

The pre-, post-, and retention tests contained the same words. The tests consisted of 50 regularly-spelled words and 50 loan words. The order of words was randomized, with the order of the pretest being different from that of the posttest, which in turn was different from the retention test. Moreover, the list of words was divided in three sections and was administered in three sessions of 34, 33, and 33 words, respectively.

Regularly-spelled words

Spelling performance of regular words was measured by a spelling-to-dictation test based on words from two standardized spelling tests ('Schaal Vorderingen in Spellingvaardigheid' of van den Bosch et al., 1991, and 'PI-dictee' of Geelhoed and Reitsma, 2004). The test contained 50 words that could be written correctly when students applied the spelling rules they had learned so far in their spelling-education program. The words are presented in Appendix A. The lowest possible score was zero and the highest was 50.

Loan words

As said, non-native Dutch or loan words cannot be spelled correctly by application of spelling rules. The most effective strategy is to learn to know these words by heart or spell them by analogy to other words that are already familiar. This test consisted of 50 loan words that were also used in the study of Paffen and Bosman (2005). The words are presented in Appendix A. The lowest possible score was zero and the highest was 50.

Spelling consciousness

Prior to writing down each dictated word, spelling consciousness was measured during the pre-, post-, and retention test. First students had to indicate whether they thought they could write the dictated word correctly or not. Students could

2 At the pre-, post-, and retention test, students were also individually interviewed about their spelling. They were asked questions about how they evaluated their spelling skills in comparison to their classmates' spelling skills, which steps they used to spell a word (when they knew the word and when they did not know the word), which words were difficult for them, and what they could do to spell words correctly. The trainer just asked these questions, but did not give suggestions regarding how to spell better.

do this by circling 'yes' when they believed they were able to write the word correctly and 'no' when they thought they were unable to write the word correctly. Next, they were asked to write the word down. Spelling consciousness was computed by counting the number of correct judgments. That is, responses that contained a 'yes' and a correctly written word or a 'no' and an incorrectly written word were considered correct. Responses that consisted of a 'yes' followed by an incorrectly written word or a 'no' and a correctly written word were considered incorrect. The lowest possible score was zero and the highest possible score was 50 for regular words and also 50 for loan words.

Words used in the training sessions[3]

All students participated in the training sessions, regardless of the condition they were in. The study contained four training sessions of 30 words each. The 120 words used in the training sessions were different from the words used in the pre-, post-, and retention test. All training words were presented only once. These words were derived from the practice assignments of the same spelling tests as the test words. Again, all regular words could be written correctly when students applied the spelling rules they had learned so far. The training words are presented in Appendix B. For each training session, the lowest possible spelling score was zero and the highest was 30.

Procedure

The test and training sessions were conducted by two Master students. Each Master student tested and trained the students from one school. They received a thorough training and a manual in which the test and training procedures were described in detail. Two weeks after the pretest, the training started. In the following four weeks, students received one training session every week. The week after the fourth training session, the posttest was performed, and five weeks after the posttest, the retention test was performed. All spelling-to-dictation tests and training sessions were administered groupwise. Table 2 presents the scores on the tests.

Strategy-instruction condition

Students in all three conditions started with a spelling test on the 30 training words in which they first had to indicate whether or not they believed they knew the spelling. Next, the students in the strategy-instruction condition were individually trained. Each student was taken to a separate room in the school and

3 In each training session, spelling consciousness was measured just as it was done in the pre-, post-, and retention test. Before students had to write down a word, they had to indicate whether they thought they could write the word correctly or not.

received his or her dictation sheet back. The student was told that all words would be discussed. For each word, the student was asked to segment the word into syllables. For each syllable, the student had to name the spelling rule(s) that had to be applied to write that syllable correctly. When the student was unable to correctly segment the word into syllables or name the particular spelling rule(s), the trainer helped the student. This procedure was repeated for all 30 words. For words that were initially written incorrectly, the student was asked, after segmenting the word into syllables and naming the spelling rule(s), to correct the word by writing the correct spelling next to the incorrectly spelled word.

Self-correction condition

After the spelling test on the training words, the students in the self-correction condition were also taken to a room in their school building and received their dictation sheets back. The students were told that they had to correct their work. Each student received a correction sheet that contained all correctly spelled words of that training session. The trainers did not check whether or not the students corrected all words. The self-correction was not directly after the dictation session. This condition was administered groupwise, students had to perform the self-correction procedure by themselves, without the help of the teacher. It was, therefore, not necessary to use individual sessions for the self-correction condition.

No-correction condition

After the spelling test on the training words, the students in this condition received no further training and they were not handed back their dictation sheets.

Table 2 Percentages Correct on the Different Tests in the Strategy-instruction, Self-correction, and No-correction Condition

		General word spelling	Pretest spelling performance	Pretest spelling consciousness
Condition				
Strategy-instruction				
	Mean	78.7	50.7	66.3
	SD	16.3	17.5	13.7
Self-correction				
	Mean	86.9	57.4	66.1
	SD	12.1	14.1	9.0
No-correction				
	Mean	79.2	52.4	66.0
	SD	16.0	18.5	14.0

Results

First, the immediate effects of the different feedback conditions were examined with respect to spelling performance and spelling consciousness. Second, the sustained effects of the different feedback conditions were examined with respect to spelling performance and spelling consciousness. We first examined whether the effects of the three conditions remained stable between posttest and retention test, and thereafter, we investigated whether there were overall effects of the three conditions between pretest and retention test. For both the immediate and sustained effects, additional questions were whether the influences of the three conditions depended on spelling ability (low- vs. high-skilled spellers) and word characteristics (regularly-spelled vs. loan words). With respect to spelling consciousness, we also checked whether the changes in spelling consciousness were caused by changes in sensitivity and/or response bias. Difference scores were used as an indicator for change in performance of the students between pretest and posttest (regarding immediate effects), posttest and retention test, and pretest and retention test (both regarding sustained effects). We chose difference scores to correct for pretest differences, albeit these were not significant and applied Bonferroni corrections to all analyses.

Immediate Effects of the Three Different Feedback Conditions

Spelling performance

To examine whether students made more progress in their spelling performance when they were taught a spelling strategy, had to self-correct their dictation, or received no feedback at all, a GLM-procedure for repeated measures was conducted in a 2 (speller: high-skill vs. low-skill) x 3 (condition: strategy instruction vs. self-correction vs. no correction) x 2 (word characteristic: regular vs. loan) design on the difference between pretest and posttest. Speller and condition were treated as between-subjects variables and word characteristic was treated as a within-subjects variable. The difference scores of the students in the three conditions are presented in Table 3.

The analyses indicated that neither the three-way interaction between speller, condition, and word characteristic ($F(2, 66) = 1.24$, $p = .30$) nor the two-way interactions between condition and speller ($F(2, 66) = 1.66$, $p = .20$), or between condition and word characteristic ($F(2, 66) = 2.92$, $p = .06$) reached significance. The main effects of speller and word characteristic were significant, but these effects warranted further qualification, because of the significant two-way interaction effect between speller and word characteristic ($F(1, 66) = 18.56$, $p < .0001$, *partial* $\eta^2 = .22$). Because this effect was not considered relevant for the aim of the present study, we will not further discuss it.

Table 3 Difference Scores for Spelling Performance on the Different Words in the Strategy-instruction, Self-correction, and No-correction Condition (%)

		Low-skilled speller			High-skilled speller		
		Strategy-instruction	*Self-correction*	*No-correction*	*Strategy-instruction*	*Self-correction*	*No-correction*
Posttest – Pretest							
All							
	M	7.2	7.4	4.3	6.3	2.3	0.4
	SD	5.3	6.5	5.9	4.7	2.6	3.7
Regular							
	M	9.1	17.4	7.1	4.6	1.7	-2.0
	SD	8.1	16.6	11.3	7.4	5.9	4.6
Loan							
	M	5.2	0.0	1.3	8.1	2.9	2.7
	SD	6.9	5.7	5.0	5.1	4.5	7.3
Retention test – Posttest							
All							
	M	2.6	-0.9	2.3	1.4	2.6	4.3
	SD	4.2	4.9	4.2	4.1	3.9	3.0
Regular							
	M	0.5	-5.7	3.6	1.1	2.5	1.2
	SD	8.1	7.1	6.7	5.5	2.7	3.9
Loan							
	M	5.0	4.0	1.2	1.6	2.6	7.3
	SD	3.7	9.7	4.7	6.2	6.2	4.5
Retention test – Pretest							
All							
	M	9.8	6.6	6.6	7.7	4.8	4.6
	SD	6.4	5.0	7.6	5.1	4.3	3.3
Regular							
	M	9.5	11.7	10.8	5.7	4.2	-0.8
	SD	9.5	14.2	13.9	7.7	6.2	3.2
Loan							
	M	10.2	4.0	2.5	9.7	5.5	10.0
	SD	7.9	5.7	6.0	7.1	4.1	7.2

The main effect of condition was significant, $F(2, 66) = 5.38$, $p < .01$, *partial* $\eta^2 = .14$. Subsequent post-hoc *t* tests revealed that students in the strategy-instruction condition made more progress between pretest and posttest than students in the no-correction condition ($p < .01$). This is also shown in Figure 1. Students in all three conditions made progress between pretest and posttest, respectively strategy-instruction ($t(26) = -7.09$, $p < .0001$), self-correction ($t(17) = -3.60$, $p < .01$), and no-correction condition ($t(26) = -2.61$, $p < .05$). No differences existed between

students in the strategy-instruction and self-correction condition (p = 1.00) or between students in the self-correction and no-correction condition (p = .13). Thus, the strategy-instruction condition was most effective for the improvement in spelling performance between pretest and posttest.

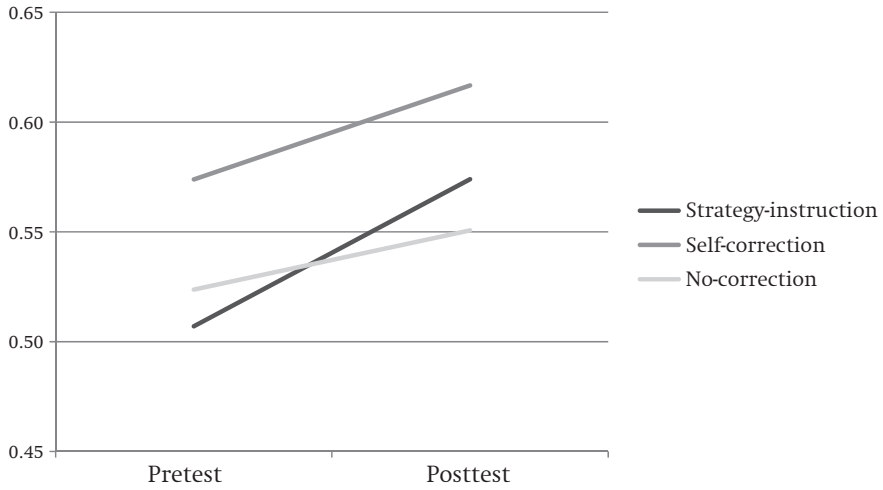

Figure 1 Progress in Spelling Performance Between Pretest and Posttest

Spelling consciousness

With respect to spelling consciousness, a similar GLM-procedure for repeated measures was conducted as described above, but now on the difference in spelling consciousness between pretest and posttest. The difference scores of the students in the three conditions are presented in Table 4.[4] The analyses indicated that neither the three-way interaction between speller, condition and word characteristic (F(2, 66) = 2.64, p = .08), nor the two-way interaction between condition and speller reached significance (F(2, 66) = .27, p = .76). The main effect of word characteristic was significant, but this effect warranted further qualification, because of the significant two-way interactions between speller and word characteristic (F(1, 66) = 13.86, p < .0001, *partial* η^2 = .17), and between condition and word characteristic (F(2, 66) = 3.92, p < .05, *partial* η^2 = .11). We are mainly interested in the interaction between condition and word characteristic. We further analyzed this interaction by focusing on the difference between the three conditions for

4 The spelling consciousness of students in all three conditions did not increase between pretest and posttest (strategy instruction, t(26) = -1.46, p = .16, self-correction, t(17) = -.23, p = .82, no correction, t(26) = 1.42, p = .17).

Table 4 Difference Scores for Spelling Consciousness on the Different Words in the Strategy-instruction, Self-correction, and No-correction Condition (%)

		Low-skilled speller			High-skilled speller		
		Strategy-instruction	*Self-correction*	*No-correction*	*Strategy-instruction*	*Self-correction*	*No-correction*
Posttest - Pretest							
All							
	M	2.7	-0.4	-4.4	2.5	1.0	-0.7
	SD	11.7	9.7	12.3	6.5	7.4	7.5
Regular							
	M	3.7	13.4	4.5	1.6	1.0	0.4
	SD	9.6	10.8	10.1	8.5	9.6	6.9
Loan							
	M	1.8	-14.4	-13.3	3.3	1.0	-1.9
	SD	17.4	19.1	20.7	7.1	12.9	13.3
Retention test – Posttest							
All							
	M	-2.1	-2.7	-0.3	2.6	2.7	2.8
	SD	12.6	6.9	6.4	4.3	5.3	2.7
Regular							
	M	-1.2	-5.1	-1.7	2.1	3.6	1.6
	SD	12.2	7.0	8.5	6.5	6.1	4.0
Loan							
	M	-3.0	-0.3	1.1	3.3	1.8	4.1
	SD	18.1	12.7	10.8	7.2	8.9	6.4
Retention test – Pretest							
All							
	M	0.6	-3.1	-4.7	5.1	3.7	2.1
	SD	10.1	15.4	13.9	7.2	8.9	6.9
Regular							
	M	2.5	8.3	2.8	3.7	4.6	1.9
	SD	9.8	7.5	14.1	9.7	5.4	8.2
Loan							
	M	-1.2	-14.7	-12.2	6.6	2.8	2.2
	SD	17.2	28.6	21.8	11.4	14.8	14.8

regular words and loan words separately. Subsequent ANOVA's revealed that for regular words, the progress between pretest and posttest did not differ between the three conditions ($F(2, 69) = .70$, $p = .50$). However, as shown in Figure 2, for loan words, the change in spelling consciousness between pretest and posttest was different for students in the strategy-instruction condition than for students in the no-correction condition ($F(2, 69) = 3.31$, $p < .05$). The spelling consciousness of students in the no-correction condition decreased ($t(26) = 2.24$, $p < .05$), whereas

that of students in the strategy-instruction ($t(26) = -1.03$, $p = .31$) and self-correction condition ($t(17) = 1.25$, $p = .23$) did not change between pretest and posttest. No differences existed between students in the self-correction and no-correction condition ($p = 1.00$), and between students in the strategy-instruction and self-correction condition ($p = .84$). Thus, for regular words, there were no differences in progress in spelling consciousness between pretest and posttest between the three feedback conditions, whereas for loan words, students in the no-correction condition had a decrease in spelling consciousness, whereas the spelling consciousness of students in the strategy-instruction condition remained stable.

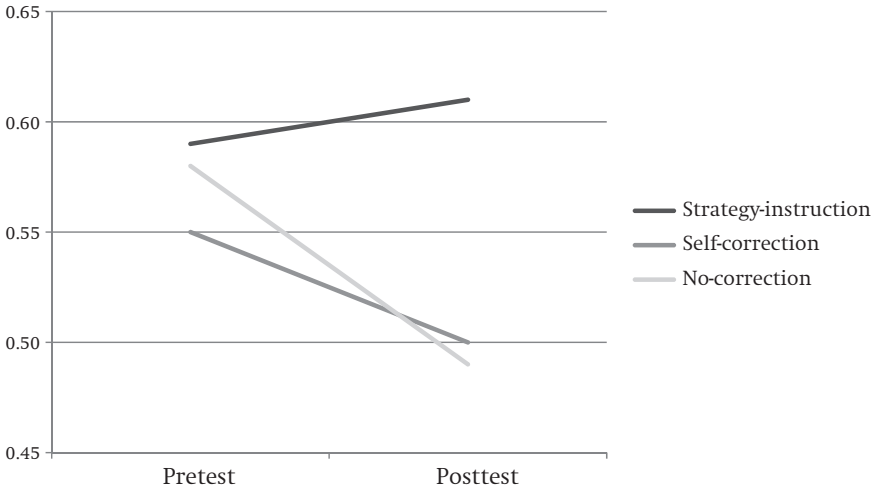

Figure 2 Progress in Spelling Consciousness Between Pretest and Posttest for Loan Words

Sustained Effects of the Three Different Feedback Conditions

Spelling performance

With respect to the sustained effects of spelling performance, a similar GLM-procedure for repeated measures was conducted as described above, but now on the difference between posttest and retention test, and thereafter on the difference between pretest and retention test. The difference scores of the students in the three conditions are presented in Table 3.

Posttest vs. retention test

The three-way interaction between speller, condition, and word characteristic was significant ($F(2, 66) = 7.01$, $p < .01$, *partial* $\eta^2 = .18$). We further analyzed this inter-

action by focusing first on regular words, and thereafter on loan words. For regular words, there was a difference between the conditions for low-skilled spellers ($F(2, 33) = 3.99$, $p < .05$). As shown in Figure 3, the change in spelling performance between posttest and retention test was different for low-skilled spellers in the self-correction condition than for low-skilled spellers in the no-correction condition ($p < .05$). The spelling performance of low-skilled spellers in the no-correction condition increased ($t(15) = -2.18$, $p < .05$), whereas that of low-skilled spellers in the self-correction ($t(6) = 2.14$, $p = .08$) and strategy-instruction condition did not change between posttest and retention test ($t(12) = -.21$, $p = .84$). No differences existed between low-skilled spellers in the no-correction and strategy-instruction condition ($p = .76$) or between low-skilled spellers in the self-correction and strategy-instruction condition ($p = .24$). For high-skilled spellers, there was no difference between the three conditions ($F(2, 33) = .34$, $p = .72$).

For loan words, there were no differences between the three conditions for low-skilled spellers ($F(2, 33) = 1.73$, $p = .19$), but there were differences for high-skilled spellers ($F(2, 33) = 3.32$, $p < .05$). This is shown in Figure 4. Subsequent post-hoc *t* tests showed that the scores of spellers in the no-correction condition increased more between posttest and retention test, than the scores of spellers in the strategy-instruction condition ($p = .06$). Only the spelling performance of high-skilled spellers in the no-correction condition increased between posttest and retention test ($t(10) = -5.36$, $p < .0001$), in contrast to spellers in the strategy-instruction ($t(13) = -.95$, $p = .36$) and self-correction condition ($t(10) = -1.36$, $p = .20$). No differences existed between spellers in the self- correction and no-correction condition ($p = .19$) or between spellers in the strategy- instruction and self-correction condition ($p = 1.00$).

Pretest vs. retention test

The analyses indicated that neither the three-way interaction between speller, condition, and word characteristic ($F(2, 66) = 3.03$, $p = .06$), nor the two-way interactions between condition and speller ($F(2, 66) = .04$, $p = .96$), or condition and word characteristic ($F(2, 66) = 1.25$, $p = .30$), or the main effects of condition ($F(2, 66) = 2.05$, $p = .14$), speller ($F(1, 66) = 2.76$, $p = .10$), or word characteristic ($F(1, 66) = .01$, $p = .92$) reached significance. The two-way interaction effect between speller and word characteristic did reach significance ($F(1, 66) = 13.29$, $p < .01$, *partial* $\eta^2 = .17$). However, this effect was not considered relevant for the aim of the present study.

To summarize, between posttest and retention test, there were no differences in progress in spelling performance between the three conditions for the spelling of regular words by high-skilled spellers and the spelling of loan words by low-skilled spellers. For the spelling of regular words by low-skilled spellers, the spelling performance increased only for spellers in the no-correction condition, spellers in this condition made significantly more progress than spellers in the

self-correction condition. For the spelling of loan words by high-skilled spellers, the spelling performance increased only for spellers in the no-correction condition, spellers in this condition made significantly more progress than spellers in the strategy-instruction condition. Between pretest and retention test, there were no differences in progress in spelling performance between the three conditions.

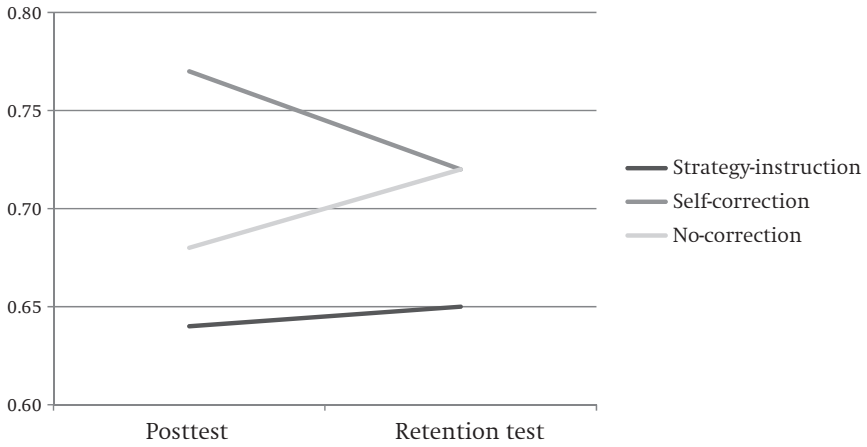

Figure 3 Progress in Spelling Performance of Low-Skilled Spellers Between Posttest and Retention Test for Regular Words

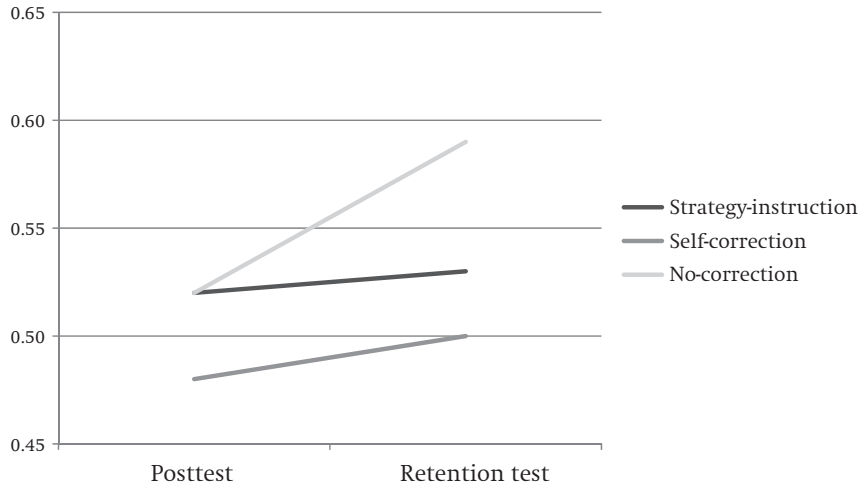

Figure 4 Progress in Spelling Performance of High-Skilled Spellers Between Posttest and Retention Test for Loan Words

Spelling consciousness

Posttest vs. retention test

With respect to the sustained effects of spelling consciousness, a similar GLM-procedure for repeated measures was conducted as described above, but now on the difference between posttest and retention test, and thereafter on the difference between pretest and retention test. The difference scores of the students in the three conditions are presented in Table 4.

The analyses indicated that neither the three-way interaction between speller, condition and word characteristic ($F(2, 66) = .68$, $p = .51$), nor the two-way interactions between condition and speller ($F(2, 66) = .15$, $p = .86$), condition and word characteristic ($F(2, 66) = .34$, $p = .72$), and speller and word characteristic ($F(1, 66) = .15$, $p = .70$), or the main effects of condition ($F(2, 66) = .20$, $p = .82$) and word characteristic ($F(1, 66) = .64$, $p = .43$) reached significance. The main effect of speller was significant ($F(1, 66) = 6.35$, $p < .05$, *partial* $\eta^2 = .09$), indicating that high-skilled spellers made more progress than low-skilled spellers.

Pretest vs. retention test

The analyses indicated that neither the three-way interaction between speller, condition, and word characteristic ($F(2, 66) = .75$, $p = .48$), nor the two-way interactions between condition and speller ($F(2, 66) = .10$, $p = .91$), and condition and word characteristic ($F(2, 66) = 1.96$, $p = .15$), or the main effect of condition ($F(2, 66) = 1.05$, $p = .35$) reached significance. The two-way interaction between speller and word characteristic was significant ($F(1, 66) = 8.68$, $p < .01$, *partial* $\eta^2 = .12$), but this effect was not considered relevant for the aim of the present study.

Thus, both between posttest and retention test, and between pretest and retention test, there were no differences in the influence of the three conditions on spelling consciousness.

Sensitivity and Response Bias

Sensitivity

To examine whether changes in spelling consciousness were due to changes in the sensitivity, we used the Signal Detection Theory (Macmillan & Creelman, 1991; Stanislaw & Todorov, 1999). First, we had to use an adjustment value of 0.5 in each cell, because some spellers had zero responses in one or more of the four cells (i.e., 'yes-correct', 'yes-incorrect', 'no-correct', and 'no-incorrect') for both regular and loan words at the pre-, post-, and retention test. Second, we computed the percentage of hit rates (number of 'yes-correct' responses divided by the total number of correctly written words) and false-alarm rates (number of 'yes-incorrect' responses divided by the total number of incorrectly written words). Table 5 presents the hit and false-alarm rates for spellers in all three conditions. Third, we

computed the sensitivity index *d'* by subtracting the z-scores of the false-alarm rates from the z-scores of the hit rates. Fourth, we conducted a GLM-procedure for repeated measures in a 3 (condition: strategy instruction vs. self-correction vs. no correction) x 2 (word characteristic: regular vs. loan) x 3 (time: pretest vs. posttest vs. retention test) design on the *d'*-scores. Condition was treated as a between-subjects variable and word characteristic and time were treated as within-subjects variables.

The analyses indicated that neither the three-way interaction between condition, word characteristic, and time ($F(4, 138) = .22$, $p = .93$), nor the two-way interactions between condition and word characteristic ($F(2, 69) = .04$, $p = .96$), condition and time ($F(4, 138) = .20$, $p = .94$), and word characteristic and time ($F(2, 138) = .005$, $p = 1.00$), or the main effects of condition ($F(2, 69) = 2.09$, $p = .13$), word characteristic ($F(1, 69) = .002$, $p = .97$), and time ($F(2, 138) = .01$, $p = .99$) reached significance. Thus, changes in spelling consciousness were not due to changes in the sensitivity between the pretest, posttest, and retention test, since the sensitivity remained stable over time, word characteristic, and condition.

Response bias

To examine whether changes in spelling consciousness were due to changes in response bias, we used the Signal Detection Theory (Macmillan & Creelman, 1991; Stanislaw & Todorov, 1999). The computation of the hit and false-alarm rates was already described above. We computed the response bias *c* by adding the z-scores of the hit rates to the z-scores of the false-alarm rates and multiplying this by -0.5. Thereafter, we conducted a GLM-procedure for repeated measures in a same design as described above for 'sensitivity'.

The analyses indicated that neither the three-way interaction between condition, word characteristic, and time ($F(4, 138) = .36$, $p = .84$) nor the two-way interactions between condition and word characteristic ($F(2, 69) = .24$, $p = .79$) and word characteristic and time ($F(2, 138) = .01$, $p = .99$), or the main effect of word characteristic ($F(1, 69) = .001$, $p = .98$) reached significance. The main effects of condition and time were significant, but these effects warranted further qualification, because of the significant two-way interaction between condition and time ($F(4, 138) = 2.96$, $p < .05$, *partial* $\eta^2 = .08$). We further analyzed this interaction by focusing on the change in *c* over time for each condition separately. Subsequent GLM analyses for repeated measures revealed that there were no changes in *c* over time between the pretest, posttest, and retention test for all three conditions, respectively, strategy instruction ($F(2, 52) = 2.74$, $p = .07$), self-correction ($F(2, 34) = .08$, $p = .93$), and no correction ($F(1.40, 36.38) = .2.76$, $p = .09$).

Subsequent ANOVA's revealed no differences in *c* between the three conditions at the pretest ($F(2, 69) = 1.86$, $p = .16$). However, as shown in Figure 5, at the posttest,

Table 5 Percentages of Hit and False-Alarm Rates in Each Condition

		Strategy-instruction		Self-correction		No-correction	
		Hit rate	False-alarm rate	Hit rate	False-alarm rate	Hit rate	False-alarm rate
Pretest							
Regular							
	M	89.3	73.3	93.6	83.8	86.9	75.7
	SD	13.8	20.1	9.9	11.5	18.2	18.0
Loan							
	M	81.4	56.9	86.8	68.8	75.4	54.8
	SD	20.3	29.6	11.1	26.1	22.4	29.3
Posttest							
Regular							
	M	88.5	72.8	97.0	87.1	93.3	84.6
	SD	13.8	20.9	5.4	13.1	12.5	15.1
Loan							
	M	76.1	53.2	88.9	74.1	82.4	69.9
	SD	21.7	33.8	14.6	21.5	19.6	23.5
Retention test							
Regular							
	M	88.9	74.2	97.8	86.9	92.0	81.5
	SD	17.2	22.3	1.8	10.3	17.8	21.4
Loan							
	M	79.8	56.8	92.2	80.0	82.2	69.8
	SD	21.9	32.5	10.2	23.0	21.4	28.8

there were differences in *c* between the three conditions ($F(2, 69) = 4.27$, $p < .05$). The *c*-value of students in the strategy-instruction condition was different from that of students in the self-correction condition ($p < .05$). No differences existed between students in the strategy-instruction and no-correction condition ($p = .12$) or between students in the self-correction and no-correction condition ($p = 1.00$). Subsequent *t* tests showed that the negative *c*-value of students in the self-correction condition was deviant from zero ($t(17) = -2.53$, $p < .05$), whereas the *c*-values of students in the strategy-instruction ($t(26) = 1.84$, $p = .08$) and no-correction condition were not deviant from zero ($t(26) = -.81$, $p = .43$). Values of *c* that are larger than zero signify a bias towards 'no-responses', whereas values of *c* that are smaller than zero signify a bias towards 'yes-responses'. Thus, students in the strategy-instruction condition had no bias, whereas students in the self-correction condition had a bias towards 'yes-responses'.

At the retention test, as shown in Figure 5, there were also differences in *c* between the three conditions ($F(2, 69) = 3.18$, $p < .05$). Again, the *c*-value of students

in the strategy-instruction condition was different from that of students in the self-correction condition ($p < .05$). No differences existed between students in the strategy-instruction and no-correction condition ($p = .69$) or between students in the self-correction and no-correction condition ($p = .47$). Subsequent t tests showed that the negative c-value of students in the self-correction condition was deviant from zero ($t(17) = -4.30$, $p < .0001$), whereas the c-values of students in the strategy-instruction ($t(26) = 1.45$, $p = .16$), and no-correction condition were not deviant from zero ($t(26) = -.07$, $p = .95$). Thus, at both the posttest and retention test, students in the strategy-instruction condition had no bias, whereas students in the self-correction condition had a bias towards 'yes-responses'.

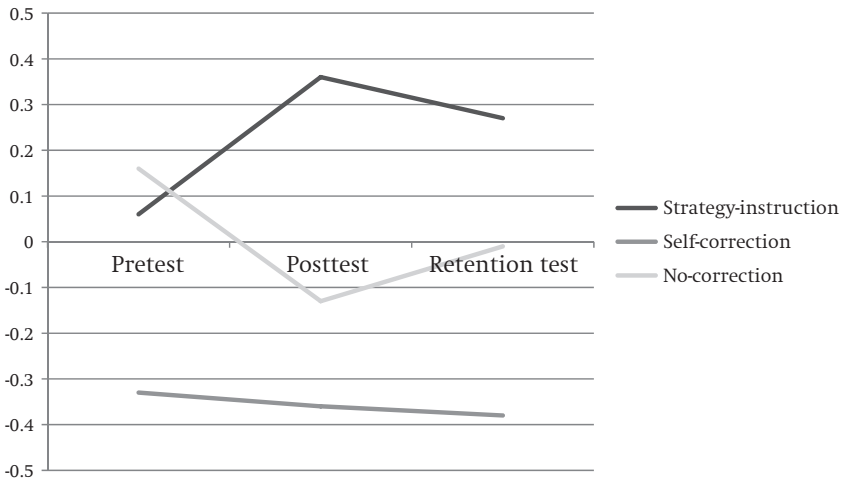

Figure 5 The c-values at the Pretest, Posttest, and Retention Test

Discussion

The present study examined how spelling performance and spelling consciousness can be improved by a spelling training. We compared the immediate and sustained effects of three different feedback conditions on both the spelling performance and spelling consciousness of third grade spellers. All students received a training that consisted of four dictation sessions in which students first had to indicate whether they were able to write the word correctly or not and thereafter had to write the word down. After each dictation session, students received one of three forms of feedback. In the strategy-instruction condition, students were taught a strategy to correct their work, in which they had to divide each word into syllables

and had to name the spelling rules that had to be applied to each syllable. In the self-correction condition, students were instructed to correct their work with the help of a correction sheet. The trainer did not check whether students really corrected all of their errors, but it appeared that students corrected almost all of their misspelled words, only about 7 percent of the misspelled words was not corrected. When students corrected their misspelled words, most of the time, they spelled the new word correctly. In the no-correction condition, students did not receive any further feedback or training.

Immediate Effects

Spelling performance

With respect to the immediate effects of the different feedback conditions on spelling performance, the strategy-instruction condition was most effective. The positive effect of strategy instruction on spelling performance is in line with previous research (Butyniec-Thomas & Woloshyn, 1997; Kernaghan & Woloshyn, 1995; Paffen & Bosman, 2005; Willemen et al., 2000, 2002). These studies also showed that teaching students a structured way to spell words leads to positive outcomes for their spelling performance. The strategy in our study focused both on syllable segmentation and teaching spelling rules. Various studies confirm the effect of syllable segmentation (Butyniec-Thomas & Woloshyn, 1997; Kernaghan & Woloshyn, 1995; Paffen & Bosman, 2005) and the teaching of spelling rules (Butyniec-Thomas & Woloshyn, 1997; Paffen & Bosman, 2005). The present study showed that strategy instruction was effective for both low- and high-skilled spellers, an effect that was also found by Paffen and Bosman (2005). Strategy instruction was also effective for both regular and loan words.

Spelling consciousness

With respect to the immediate effects of the different feedback conditions on spelling consciousness, the strategy-instruction condition was more effective than the no-correction condition for the writing of loan words. Students in the no-correction condition had a decrease in spelling consciousness between the pretest and the posttest, whereas the spelling consciousness of students in the strategy-instruction condition remained stable. An explanation might be that students in the strategy-instruction condition may have become more aware of their spelling during the writing of words because they had to apply the strategy to each word. They might be triggered to think more about their spelling during the spelling process than students in the no-correction condition. Students in the no-correction condition were not triggered to think more about their spelling, and they might be more inclined to overestimate their spelling ability. An explanation for the fact that this was only visible for loan words might be that

students made more errors on loan words than on regular words, so an overestimation of the spelling ability would have more effect on the spelling consciousness scores on loan words than on regular words.

These findings are in line with that of Paffen and Bosman (2005). They found that only students who received the training were better at indicating which words they could not spell correctly. It is important for students to know which words are difficult for them, because then they can pay extra attention to those words, ask the teacher for help, and, even more importantly, they can work on these difficulties.

Sustained Effects

Spelling performance

As we expected, the positive effect of the strategy-instruction condition faded out after the training stopped. Between the posttest and the retention test, for low-skilled spellers, the spelling performance of regular words increased only for students in the no-correction condition. Spellers in the no-correction condition made significantly more progress than spellers in the self-correction condition. For high-skilled spellers, the spelling performance of loan words increased only for students in the no-correction condition. These spellers made significantly more progress than students in the strategy-instruction condition. However, the overall effect between the pretest and the retention test showed that there were no differences in progress in spelling performance between the three conditions.

This provides evidence for the importance of spelling instruction, even for high-skilled spellers. After the spelling training had stopped, the positive effect had faded out. A possible explanation is that only four strategy-instruction sessions is not enough for third grade students to internalize the strategy and to apply it after the training stopped.

Spelling consciousness

Again, as expected, the effects of the training conditions disappeared after the training had stopped. Both between the posttest and the retention test, and between the pretest and the retention test, there were no differences in the influence of the three feedback conditions on spelling consciousness.

Again, these results showed evidence for the importance of instruction, and especially strategy instruction, for students to improve their spelling consciousness. This is not only confirmed by the fact that the spelling consciousness of loan words of students in the strategy-instruction condition remained stable, whereas that of students in the no-correction condition, in which they received no feedback, decreased, but also because after the posttest, the strategy-instruction condition was no more effective than the no-correction condition anymore.

That the sustained effects of spelling-consciousness were the same for the three conditions, might be explained by the large amount of experience with judging the own spelling of students in all three conditions. All students had to judge their spelling in the pretest, training sessions, posttest, and retention test, which means they had to judge the spelling of 420 words. The positive effect of judging one's own spelling on spelling consciousness was also mentioned in the study of Paffen and Bosman (2005). In their study, the students in the control group also improved their spelling consciousness, most likely as a result of the judgments made during the test-sessions.

The results of the Signal Detection Theory measures showed that changes in spelling consciousness were not due to changes in the sensitivity between the pretest, posttest, and retention test. The bias towards 'yes' or 'no' was the same for the three conditions at the pretest. However, at the posttest and retention test, students in the strategy-instruction condition had no bias, whereas students in the self-correction condition had a bias towards 'yes-responses'. This indicates that strategy instruction may lead to more accurate judgements than self-correction.

The data on the percentage of judgments in each spelling-consciousness category revealed that spellers did not make valid 'no'-responses on regular words before training. When they predicted that they did not know how to spell the word, they were as likely to be correct as incorrect. However, on loan words they were quite accurate. Note, however, that the difference in spelling consciousness between loan words and regular words was not just due to the fact that they were less familiar with loan words. Students knew the meaning of most loan words, and when they did not, the meaning was explained by the experimenter. Moreover, there were also regular words with which students were not very familiar or which they had never written before. The fact that students can hear that loan words have different sounds than prototypical Dutch words was demonstrated by Sap and Bosman (2008). In their study, students from second grade were already able to indicate which words were originally Dutch and which words were derived from another language.

Self-confidence may have had an influence on the development in spelling consciousness. Spellers with a low self-confidence may have fewer 'yes-correct' and more 'no-correct' judgments than spellers with an average self-confidence. One might say that it is this confidence that increases during training. Indeed, the basic data show that the percentage of 'yes-correct' judgments increased over time, whereas the percentage of 'no-incorrect' decreased over time. This suggests that it is self-confidence that increased during training. However, it is not only self-confidence that causes the development in spelling consciousness, because on loan words, the percentage of 'no-correct' judgments increased rather than decreased during training. Thus, confidence may have some influence on spelling consciousness, it does not explain all of the effects.

To summarize, with respect to the immediate effects of the training both on spelling performance and spelling consciousness, the strategy-instruction condition was most effective. With respect to the sustained effects, as was expected, the effects of strategy-instruction training faded out after the training stopped. This revealed the transient nature of the changes in spelling performance induced by the instructional manipulations in our study. More training sessions are probably required to find sustained effects after the training stopped.

Practical Implications

Our study showed that both spelling performance and spelling consciousness can be improved by a short spelling training. Since higher levels of spelling consciousness go along with higher levels of spelling performance[5], it is useful to incorporate training on spelling consciousness in spelling instruction. The findings of the present study confirmed previous research that indicated the importance of proper spelling instruction. We showed the positive effects of our short training, but also the transient nature of the improvement in spelling performance induced by the training, in that positive effects decline after the training had stopped.

For clinical practice, this means that teachers should pay sufficient attention to proper spelling instruction that focus on both spelling performance and spelling consciousness. Spelling performance and spelling consciousness can be improved by teaching students a spelling strategy that offers them a structured way to spell words. An effective strategy is to have students segment words into syllables and let them think of the spelling rules that can be applied to each syllable. Both low- and high-skilled spellers need instruction and experience in both aspects of spelling. More importantly, instruction requires permanent attention both on spelling performance and spelling consciousness.

5 In additional analyses, we established that spelling performance and spelling consciousness were related in our study, at the pretest ($r = .65$, $p < .0001$), posttest ($r = .77$, $p < .0001$), and retention test ($r = .86$, $p < .0001$). High spelling performance went along with high spelling consciousness, and vice versa.

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Appendix A. Words used in the pre-, post-, and retention test

Regularly spelled words	Loan words
brandnetels [nettles]	ruïne [ruins]
smokkelaars [smugglers]	explosie [explosion]
voetballer [soccer player]	theater [theater]
stromen [streams]	lucifer [match]
schaduw [shadow]	fantastisch [fantastic]
sneeuwmannen [snowmen]	exotisch [exotic]
bericht [message]	orthodontist [orthodontist]
kastdeur [door of a closet]	bureau [desk]
beloning [reward]	chirurg [surgeon]
broodtrommel [bread box]	bibliotheek [library]
vogeltjes [little birds]	computer [computer]
verlegen [shy]	champignons [mushrooms]
koffertje [little suitcase]	plafond [ceiling]
vleesgerecht [meat-course]	maximum [maximum]
tomaten [tomatoes]	charmant [charming]
hoofdletter [capital]	ambulance [ambulance]
boterhammen [slices of bread]	spaghetti [spaghetti]
meeuwen [gulls]	illustratie [illustration]
krokodillen [crocodiles]	politie [police]
hardloper [runner]	cadeau [gift]
fluitketel [singing teakettle]	machinist [train driver]
getallen [numbers]	hobby [hobby]
oppassen [taking care]	centrum [centre]
brutaal [rude]	taxi [taxi]
schreeuw [scream]	hallucinatie [hallucination]
ongeveer [approximately]	cheque [cheque]
slaapzalen [dormitories]	liniaal [ruler]
fakkeloptocht [torch ceremony]	etalagepop [window dummy]
stoppelbaard [stubbly beard]	garagepoort [garage gate]
schommel [swing]	cirkel [circle]
vriendschap [friendship]	echo [echo]
verzameling [collection]	benzine [gasoline]
roeiers [rowers]	marathon [marathon]
zweefmolen [giant's stride]	apotheek [pharmacy]
kieuwen [gills]	punaise [thumbtack]
voorzitter [chairman]	romantisch [romantic]
toestemming [permission]	bioscoop [cinema]
weerverswachting [weather forecast]	meubilair [furniture]

bedankt [thanks]	centrifuge [centrifuge]
zelfbeheersing [self-control]	niveau [level]
bekeuring [penalty]	accommodatie [accomodation]
enkel [ankle]	architect [architect]
lawaai [noise]	journalist [journalist]
waterdruppels [drops of water]	uniform [uniform]
volwassenen [adults]	typen [to type]
oorverdovend [deafening]	export [export]
ademhaling [breath]	asperges [asparagus]
mooiste [prettiest]	expositie [exposition]
verfkwast [paintbrush]	emigratie [emigration]
gastspreker [guest speaker]	horloge [watch]

Appendix B. Words used in the training sessions

Session 1	Session 2
regen [rain]	bakker [baker]
schatkist [treasure chest]	tevreden [satisfied]
kralen [pellets]	zwaai [sway]
kreeft [lobster]	standhut [beach cabin]
avonturen [adventures]	middelen [means]
angst [fear]	opnieuw [again]
kassa [pay desk]	rugzakken [backpacks]
woord [word]	luchtballon [balloon]
vlokken [flakes]	bedlampje [bed lamp]
tovenaar [wizard]	kastelen [castles]
mond [mouth]	koektrommel [cookies box]
opener [opener]	kamerplanten [indoor plants]
pennen [pens]	broodplank [bread board]
schepen [ships]	bedden [beds]
handbal [handball]	verhalen [stories]
geweer [gun]	teleurstelling [disappointment]
paraplu [umbrella]	rondvaart [circular cruise]
oplichters [swindlers]	petten [caps]
appelstroop [apple treacle]	personen [people]
boerinnen [farmer's wives]	spannend [exciting]
vuist [fist]	ondeugend [naughty]
verschillen [differences]	kantoortje [small office]
stekelvarken [porcupine]	kannetje [cannikin]
spelletje [game]	beweging [movement]
sneeuwstorm [blizzard]	brillen [pairs of glasses]
broodkorst [bread crust]	garnalen [shrimps]
fietszadel [bike saddle]	geschreeuw [yelling]
geeuw [yawn]	gespetter [splash]
komkommer [cucumber]	vertrokken [departed]
vanzelfsprekend [obviously]	soeplepel [soup-ladle]

Session 3	Session 4
spuit [injection needle]	sprinkhanen [grasshoppers]
verkeerslicht [traffic-light]	veldmuis [field mouse]
ballonnen [balloons]	samenkomst [meeting]
hagelslag [chocolate sprinkles]	gehaktballen [meatballs]
kippenhok [hennery]	kantoren [offices]
brandstichter [arsonist]	kroketten [croquettes]
hobbelpaard [rocking horse]	schelpen [shells]
mededeling [announcement]	evenwicht [balance]
oktober [October]	geschrokken [frightened]
oppervlakte [surface]	bestemming [destination]
samen [together]	angstdromen [nightmares]
schatkamer [treasury chamber]	kennissen [acquaintances]
slaapkamer [bedroom]	slangen [snakes]
vergissing [mistake]	opvallend [remarkable]
aardbeving [earthquake]	tekeningen [drawings]
drinkwater [drinking water]	zangvogel [singing-bird]
gebaren [gestures]	voorstellingen [exhibitions]
kammetje [little brush]	voetstappen [footsteps]
melktand [primary tooth]	verkeerd [wrong]
nieuwsbrief [news letter]	brand [fire]
overdag [by day]	leeuwinnen [lionesses]
prinsessen [princesses]	ogenblikje [moment]
middelpunt [centre]	belangstelling [interest]
optocht [procession]	onverstoorbaar [imperturbable]
soldaten [soldiers]	ongelukken [accidents]
spoorloos [trackless]	verpleger [nurse]
spreeuwen [starlings]	uitstekend [excellent]
springstoffen [explosives]	vloeistoffen [fluids]
pudding [pudding]	woning [home]
toernooi [tournament]	vliegveld [airport]

Chapter 7

The role of instruction for spelling performance and spelling consciousness across words, interventions, and spellers

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This chapter has been submitted as:
Cordewener, K. A. H., Bosman, A. M. T., & Verhoeven, L. (2014).
The role of instruction for spelling performance and spelling consciousness across words, interventions, and spellers.

Abstract

The aim of the present study was to examine the role of instruction for spelling performance and spelling consciousness across words, interventions, and spellers. A sample of 88 third-grade spellers with a mean age of 8 years and 5 months was assigned to a strategy-instruction, strategic-monitoring, or self-monitoring condition in which metacognitive aspects were implemented in different extents. The results showed that the effect of instruction on both spelling performance and spelling consciousness was universal for type of words, interventions, and spellers. The instruction conditions had the same effect on regular as on loan words, the progress was the same for students in the three intervention conditions, and the effects and the progress were the same for low- and high-skilled spellers. Students became more accurately in assessing which words they could or could not spell correctly. For educational practice, this suggests that teachers can use strategy instruction, strategic monitoring, and self-monitoring to improve both spelling performance and spelling consciousness. Moreover, low- and high-skilled spellers alike will profit from the same instruction.

The Role of Instruction for Spelling Performance and Spelling Consciousness across Words, Interventions, and Spellers

When children are first learning to spell, they will discover that each word is a composition of various phonemes and that each phoneme can be connected to a corresponding grapheme. When children are able to segment words into phonemes and to connect phonemes to the corresponding graphemes, they are able to write words correctly that are consistent in their phoneme-to-grapheme relationships. However, after a while, children will learn that a large number of words are inconsistent in their phoneme-to-grapheme relationships and can only be spelled correctly when spelling rules are used. From this moment on, children have to think about how they spell words and whether these words are correctly spelled or not. Reflecting on their spelling process and the ability to detect and correct one's spelling errors is called spelling consciousness (Block & Peskowitz, 1990; Bosman, 2004; Lull, 1917). Previous studies have shown that students are not very good at evaluating the correctness of their spellings (Hendrickson & Pechstein, 1926; Koning, 1985; McFarland, as cited in Lull, 1917). However, spelling consciousness is highly related to spelling performance (e.g., Block & Peskowitz, 1990; Deshler, Ferrell, & Kass, 1978; Hendrickson & Pechstein, 1926; Jansen-Donderwinkel, Bosman, & van Hell, 2002; Willemen, Bosman, & van Hell, 2002). Therefore, research on how to improve spelling consciousness is welcome.

Cordewener, Verhoeven, and Bosman (2014) compared the effect of three feedback conditions on both spelling performance and spelling consciousness of third-grade students. In the strategy-instruction condition, they taught students a strategy to correct their dictation by having them segment words into syllables and name and use the spelling rules that could be applied to each syllable. Only highly generalizable spelling rules were used in this strategy. In the self-correction condition, students self-corrected their spellings, but not directly after dictation. In the no-correction condition, student received no feedback on their dictation. The results indicated that strategy instruction was most effective for spelling performance on both regular and loan words and for spelling consciousness on loan words. However, in this previous study, students had to apply the strategy after dictation, whereas it may be even better when they apply it before they write down each word. This may stimulate them to think before and during their spelling. Moreover, the effect of implementing metacognitive aspects in combination with teaching a strategy is also unknown, as is the effect of self-monitoring by correction immediately after dictation. Therefore, in the present study, we provided students with one of three training conditions in which metacognitive

aspects are implemented to different extents. The students in the strategy-instruction condition were taught a strategy that they had to apply before writing each word. When teaching students a structured way to spell, their metacognitive skills may improve without explicitly stimulating their metacognitive thinking by asking them questions. Students in the strategic-monitoring condition were asked metacognitive questions after they performed a dictation and were taught a strategy that they had to apply to incorrectly written words. Students in the self-monitoring condition were allowed to self-correct their work directly after dictation. To self-correct a dictation, one has to be aware of one's spelling errors. Practice with self-correction may improve metacognitive skills without explicitly asking students to think about their spelling process.

In the present study, the role of instruction on spelling performance and spelling consciousness was examined by determining whether the effect of instruction depends on word type, type of intervention, or the speller. With respect to word type, the effects for regular words were compared to the effects for loan words. Loan words are words that have their origin in another language than Dutch and, consequently, cannot be spelled correctly by just applying Dutch spelling rules. With regard to intervention type, we compared the effects of the three instruction conditions (i.e., strategy instruction, strategic monitoring, and self-monitoring). And with reference to the speller, we compared the effects of instruction for low- and high-skilled spellers.

Spelling Performance and Spelling Consciousness

One possible way to improve spelling performance and spelling consciousness is to stimulate students' metacognition. Metacognition refers to the awareness and thinking about one's cognitive processes and strategies (Flavell, 1979). Metacognitive skills can help students to learn more effectively (Fisher, 1998). These skills develop with age and experience (Flavell, Green, & Flavell, 1995). Nevertheless, even young students can have metacognitive strategies that help them to learn efficiently (Flavell et al., 1995). Some studies indicate that the acquisition of metacognitive skills requires explicit teaching (Fisher, 1998; Slife, Weiss, & Bell, 1985), whereas other studies suggest that metacognitive skills may also develop as a result of experience with and the use of cognitive strategies. This was particularly true for older students (Brown & Barclay, 1976; Brown, Campione, & Murphy, 1977). Thus, the extent in which metacognitive skills have to be explicitly taught is yet unknown.

Metacognition becomes increasingly important during spelling development. In the early phase of spelling development, students learn phonemes (i.e., the sounds of a language) and their corresponding graphemes (i.e., the alphabetic characters of a language). For example, they learn that the phoneme /s/ corresponds

to the grapheme S. When they are just learning to spell, students mainly acquire words that are consistent in their phoneme-to-grapheme correspondences (e.g., STOP and STAR in English, KUS [kiss] and STER [star] in Dutch). These words can be spelled by segmenting the word into phonemes and writing down the graphemes that correspond with the phonemes (Ehri & Wilce, 1987; Morris & Perney, 1984). An example is segmenting the word STOP into the phonemes /s/, /t/, /o/, and /p/ and writing down their corresponding graphemes S, T, O, and P. The spelling of these words is relatively easy compared to the spelling of words that are not consistent in their phoneme-to-grapheme correspondences, of which there are a lot more in English than in Dutch (e.g., DREAM and HOPE in English, KIKKER [frog] and BOMEN [trees] in Dutch). However, further on in the spelling development, students have to acquire these phoneme-to-grapheme inconsistent words. From this point on, metacognition becomes important, because these words can only be written correctly when phonological, morphological, and/or orthographic spelling rules are applied, when they are written by analogy to other words, or when they are known by heart. To spell these words correctly, students have to think about how to apply rules or about ways or strategies of discovering the correct spelling.

For spelling, metacognition involves thinking and reflection about the way of how to spell a word, being able to know which strategy can be used in which particular situation, and also being able to apply these strategies correctly. Therefore, in the present study, not only the effects of the three conditions on spelling performance, but also the effects on spelling consciousness were examined.

Being conscious of one's spelling is important to become a good speller (Lull, 1917). That is, students who are able to evaluate the correctness of their spelling accurately have a higher spelling-performance level (Block & Peskowitz, 1990; Hendrickson & Pechstein, 1926), and are also better at choosing the most appropriate spelling strategies for writing particular words (Kreiner & Green, 2000).

A number of studies revealed that students of various ages do not have a proper level of spelling consciousness (Hendrickson & Pechstein, 1926; Koning, 1985; McFarland, as cited in Lull, 1917). Some studies showed that students were able to accurately indicate when they spelled a word correctly, but had problems indicating when they spelled a word incorrectly (Hendrickson & Pechstein, 1926; Tidyman, 1919). Moreover, there were large individual differences in the level of spelling consciousness of students (Hendrickson & Pechstein, 1926; Kreiner & Green, 2000). Other studies showed that students increased their level of spelling consciousness, because they mainly used words in their free writing assignments that they knew how to spell (Jansen-Donderwinkel et al., 2002), or because they asked the help of others when they did not know how to spell a particular word (Gunderson, 1943).

Only a few studies have focused on ways to improve the spelling consciousness of students (Block & Peskowitz, 1990; Paffen & Bosman, 2005). It appeared that the level of spelling consciousness of students can be improved by a short training. Students who visually inspected their spelling after writing, became better at accurately estimating the correctness of their spelling (Block & Peskowitz, 1990). Visual inspection of the word was even more effective when it went along with pronunciation of the word. Paffen and Bosman (2005) developed a spelling-consciousness training. In five sessions, students were made aware of their spelling and spelling difficulties and were taught metacognitive strategies. Students were stimulated to think about their spelling process, their difficult words, ways to spell difficult words, and the correctness of their spellings by asking them questions and teaching them strategies to spell correctly. After the training, students were better able to accurately indicate which words they had spelled correctly and which words they had spelled incorrectly. Students in the control group did not receive the training, but also had to estimate the correctness of their spelling during the pretest and posttest. It appeared that these control-group students did not become better at indicating which words they could not spell correctly, although they became better at indicating which words they could spell correctly. Freeman, Graham, and Harris (1988) showed that a training to memorize words, without explicit metacognitive-skill training, already caused an improvement in spelling consciousness. These studies suggest that only the experience of examining the correctness of one's spelling already improved spelling consciousness.

Thus, although many spellers do not have a high level of spelling consciousness, spelling consciousness can easily be improved by effective spelling instruction. The role of instruction for both spelling performance and spelling consciousness can be determined by examining the effects for different types of words and interventions as well as by the level of the speller.

Word Type

Because the Dutch language contains words that are originally Dutch and words that have their origin in another language, students have to learn to spell two types of words. Originally Dutch words are spelled according to the Dutch spelling rules, whereas loan words cannot be spelled according to Dutch spelling rules (Bosman, 2004). In the present study we included both regularly spelled words that could be spelled correctly by applying the rules the students had learned so far, and irregular or loan words that could not. To obtain an accurate measure of spelling consciousness, both words that could be spelled correctly and words that could, most probably, not be spelled correctly have to be included in the study. Loan words are not trained in the present study, and the strategy that was taught in the strategy-instruction and strategic-monitoring condition, cannot be applied

to loan words. However, this strategy can be applied to particular parts of loan words. Because loan words are part of spelling education, we also examined whether students make progress in both spelling performance and spelling consciousness on these words.

Intervention Type

In the past decades, research has revealed that adequate spelling instruction is necessary to reach a proper spelling level (e.g., Bosman, 2004; Bosman & de Groot, 1992; Butyniec-Thomas & Woloshyn, 1997; Devonshire & Fluck, 2010; Faber, 2006; Gettinger, Bryant, & Fayne, 1982; Graham 1999, 2000; Wanzek, Vaughn, Wexler, Swanson, Edmonds, & Kim, 2006). These studies focused on the best ways for students to memorize a word's spelling (e.g., Bosman, van Hell, & Verhoeven, 2006; Graham & Freeman, 1985; Hilte & Reitsma, 2006; Hubbert, Weber, & McLaughlin, 2000; Murphy, Hern, Williams, & McLaughlin, 1990; Ormrod & Jenkins, 1989), the best ways to learn a spelling rule (Butyniec-Thomas & Woloshyn, 1997; Cordewener, Bosman, & Verhoeven, 2014; Darch, Eaves, Crowe, Simmons, & Conniff, 2006; Hilte & Reitsma, 2011; Kemper, Verhoeven, & Bosman, 2012), and the best ways to stimulate students to apply spelling rules in a structured way (Butyniec-Thomas & Woloshyn, 1997; Kernaghan & Woloshyn, 1995; Paffen & Bosman, 2005).

With respect to memorization of words, students have to memorize each word separately, and as a result may develop the wrong belief that there are no underlying regularities for the spelling of words (Berninger, Vaughan, Abbott, Brooks, Abbott, Rogan, Reed, & Graham, 1998; Henry, 1989). Another disadvantage of sheer memorization is that it is impossible to memorize each particular word of a language separately. In contrast, when a spelling rule is taught to students, they should not just be able to write the practiced words correctly, but also become able to transfer the acquired knowledge to other words within that same word category. However, when students are taught a structured way to apply spelling rules, they may be able to write words of various word categories correctly. An example of a structured way to apply spelling rules, is the segmentation of a word into syllables and the usage of the spelling rule(s) that can be applied to each syllable. Previous research has indicated that teaching such a spelling strategy to students improved their spelling performance (Butyniec-Thomas & Woloshyn, 1997; Cabán, Hambleton, Coffing, Conway, & Swaminathan, 1978; Kernaghan & Woloshyn, 1995; Paffen & Bosman, 2005; Torneus, 1984). Various studies included syllable segmentation (Butyniec-Thomas & Woloshyn, 1997; Kernaghan & Woloshyn, 1995; Paffen & Bosman, 2005) and the teaching of spelling rules (Butyniec-Thomas & Woloshyn, 1997; Paffen & Bosman, 2005) in their strategy instruction. Although teaching a spelling strategy is regarded an effective way to improve spelling performance on a large number of different words, the effect on spelling consciousness is still

unknown. Three possible ways to improve both spelling performance and spelling consciousness, that are the focus of this study, are strategy instruction, strategic monitoring, and self-monitoring.

Strategy instruction

Students often fail to use efficient learning strategies unless they receive explicit instruction in these spelling strategies (Graham, 1983; Graham & Freeman, 1985). Some studies suggest that teaching students a strategy may already improve their metacognitive skills (Brown & Barclay, 1976; Brown et al., 1977). Mere thinking about how to handle a particular task can stimulate metacognitive skills. Various studies showed the effectiveness of teaching a strategy that involved the segmentation of a word into phonemes or syllables. Already in 1919, Tidyman advised teachers to have students divide the word into syllables and have them think about the difficulties of each syllable (Tidyman, 1919). There are also studies that established the effectiveness of including the teaching of a rule as a part of a strategy instruction (Butyniec-Thomas & Woloshyn, 1997; Cordewener, Verhoeven, & Bosman, 2014; Darch et al., 2006; Hilte & Reitsma, 2011; Kemper et al., 2012). The intervention study of Kernaghan and Woloshyn (1995) also provided students with a spelling training that included a strategy instruction. Students were taught to isolate and identify all sounds in words. This training also contained a metacognitive part in which students were taught when and how to use that strategy. They found that even first-grade students were able to learn spelling strategies. Paffen and Bosman (2005) offered students a strategy-instruction training to improve both spelling performance and spelling consciousness. In this training, students were made aware of their own spelling and were taught metacognitive strategies. An example of such a strategy is that students were taught to carefully listen to the word, segment the word into syllables, and think for each syllable about the spelling rules that have to be applied to spell the word correctly. This training appeared to be effective for both poor and good readers/spellers. Thus, researchers agree that students have to actively think about their spelling before writing down a word. By offering them a structured way to think about each part of the word, they may be stimulated to think actively about their spelling without explicit metacognitive instruction.

Strategic monitoring

Various studies have already shown that metacognitive skills can be taught to students, but the best way to do this is still unknown. A large number of studies have established that students are stimulated to think about their own learning processes when metacognitive questions are asked (Fisher, 2007; Jacobs, 2004; Olson & Astington, 1993). Jacobs (2004) even showed that asking metacognitive

questions after writing activities causes students to become more aware of the strategies they were using. To sum up, when students are encouraged to think about why they perform tasks a particular way, their metacognition and their performance on these tasks may improve, especially when metacognitive questions are combined with teaching a strategy to correct their incorrectly spelled words.

Self-monitoring

Another effective way to improve spelling performance of students is to have them self-correct their work, by asking them to compare their spelling with the one on the correction sheet and to correct their spelling when needed (Morton, Heward, & Alber, 1998). Several studies have shown the effectiveness of self-correction for students of different educational levels (Grskovic & Belfiore, 1996; McGuffin, Martz, & Heron, 1997; McNeish, Heron, & Okyere, 1992; Willemen, Bosman, & van Hell, 2000, 2002; Wirtz, Gardner, Weber, & Bullara, 1996). Gettinger (1985) found that poor spellers profit more when they have to self-correct than by corrections made by teacher. Self-correction may also be effective to improve the spelling consciousness of students (Block & Peskowitz, 1990; Willemen et al., 2002). When students are able to self-correct their work, they are able to detect their own errors, so this means they have some level of spelling consciousness. This indicates that metacognitive skills can be triggered by having spellers compare their own spelling with the correct spelling. In the study of Willemen et al. (2002), students in the self-correction training already made fewer errors during the writing of their text. Thus, they did not only become better in detecting their spelling errors, but they also started thinking more about their spelling during the spelling of words. Cordewener, Verhoeven, and Bosman (2014) found no effect of the self-correction procedure on spelling consciousness, but in this study, students were not allowed to self-correct their work immediately after dictation. To conclude, more evidence is needed, because it is yet unclear whether spelling consciousness of students improves by just having them correct their own work without explicit metacognitive instruction.

Speller

Another important issue is whether the spelling processes of good spellers are the same as the processes of poor spellers. Younger students and students with learning difficulties are worse in judging their own performances (Loper, 1984; Slife et al., 1985) and tend to overestimate their skill (Brown et al., 1977). Deshler et al. (1978) provided evidence for this in the area of spelling. They found that poor spellers were generally more confident about their own spelling than good spellers, and consequently, they were less inclined to check their spelling. Poor spellers may not only have a delay in spelling performance, but also in spelling consciousness.

There is also a difference between poor and good spellers in the strategies they use. Snow (in Block & Peskowitz, 1990) showed that good spellers mastered several spelling strategies and also used these strategies while spelling words, whereas poor spellers did not master several spelling strategies, and consequently, did not use strategies very often. Snow suggested that explicit strategy instruction might be particularly helpful for poor spellers. Graham and Freeman (1985) also concluded that students with learning disabilities often fail to develop efficient study strategies for the memorization of the spelling of words by themselves.

Since poor spellers have a delay in spelling consciousness and have difficulties with developing efficient strategies, adequate spelling instruction may be especially important for poor spellers (Gettinger et al., 1982; Graham, 1999, 2000). However, it is still unclear whether poor spellers need different spelling instruction than good spellers. The results of Willemen et al. (2000, 2002) provided evidence that poor and good spellers profit similarly from the same spelling instruction, but poor spellers depend more on spelling instruction than good spellers. Note that, in their studies, they did not include poor and good spellers, but students from special and regular education. However, students with learning disabilities are often also poor spellers (Deshler, Schumaker, Alley, Warner, & Clark, 1982), so the results for students from special education may be the same as for poor spellers. Cordewener, Bosman, and Verhoeven (2014) also showed that poor and good spellers profited from the same spelling instruction. For words with the morphological rule, poor and good spellers even made an equal amount of progress. The intervention study for spelling consciousness of Paffen and Bosman (2005) also showed that poor readers/spellers need the same spelling instruction as good readers/spellers. In their study, spelling consciousness of poor readers/spellers increased as much as that of good readers/spellers. Thus, in contrast to reading, in which good readers generally profit more from instruction than poor readers, in spelling there is also evidence that poor and good spellers profit in an equal amount of spelling instruction.

To summarize, research showed that the ability to assess the correctness of their own spelling and the spelling strategies that they use may differ between poor and good spellers. It is, however, still unclear whether the most effective instruction may be different for poor and good spellers and whether they profit equally from instruction.

Present Study

In the present study, we examined the role of instruction for different types of words, interventions, and spellers on spelling performance and spelling consciousness. Spelling performance was examined by having students spell both regular and loan words. Spelling consciousness was measured by having students

assess whether they thought they were able to spell these words correctly or not, before they were allowed to write each word down. The judgments of students are divided in four categories (i.e., 'yes-correct', 'yes-incorrect', 'no-correct', and 'no-incorrect'). We did not only take into account the percentage of correct judgments, but we also looked into more detail at the change of distributions of judgments over time and the effect of the three training conditions on these distributions.

The aim of the present study was to examine to which extent instruction would yield universal outcomes across words and interventions, and high- and low achieving spellers for both children's spelling performance and spelling consciousness. With respect to word type, we examined whether the instruction conditions had the same effect on regular as on loan words. With respect to intervention type, we compared the effect of three training conditions in which metacognitive aspects were implemented to different extents. In the strategy-instruction condition, students were taught a strategy which they had to apply before they had to write down each word. The strategy involved segmenting the word into syllables and mentioning the spelling rule(s) that could be applied to each syllable (Cordewener, Verhoeven, & Bosman, 2014). Only highly generalizable spelling rules were used. We tried to stimulate these students to think about their spelling during the spelling process, instead of afterwards. In the strategic-monitoring condition, students were taught the same strategy that they had to apply to words that they had written incorrectly. In addition to this strategy, metacognition of students was also explicitly stimulated by asking them metacognitive questions. In the self-monitoring condition, the students got the opportunity to immediately self-correct their work after dictation. Finally, with respect to the speller, we examined whether the instruction conditions had the same effect on low- and high-skilled spellers.

Method[1]

Participants

In the present study, 88 third-grade students (45 girls, 43 boys) between the ages of 88 and 117 months (M = 100.8, SD = 5.4) participated. For all students, Dutch was the dominant language. All students, except six, spoke Dutch at home; one student spoke Moroccan at home, and five students used a combination of Dutch and another language (i.e., English, Moroccan, Papiamentu, Lebanese, and Turkish). The students were from three classes of three different schools for primary education in the Netherlands; all three schools used the same spelling-education

1 This study was based on a previous study we performed, so parts of the Method section are similar to those in the previous study (Cordewener, Verhoeven, & Bosman, 2014).

method 'Taal Actief' ([Language Active] Fuchs, de Goei, van den Heuvel, & de Geus, 2002) ensuring that all students had learned the spelling rules in the same way. Based on their scores on a standardized word-spelling test, their spelling performance on the pretest, their spelling consciousness on the pretest, their age, and their sex, students of each class were assigned to one of the three different conditions. The strategy-instruction condition comprised 13 girls and 15 boys (age: M = 100.8, SD = 6.2), the strategic-monitoring condition had 16 girls and 14 boys (age: M = 101.0, SD = 5.9), and the self-monitoring condition consisted of 16 girls and 14 boys (age: M = 100.6, SD = 4.1). Note that, for the analyses concerning spelling performance, spellers were divided into the 47 percent spellers with the highest spelling consciousness scores (scores above .58) and the 53 percent spellers with the lowest spelling consciousness scores (scores below .59), based on the pretest for word spelling. With respect to the analyses concerning spelling consciousness, students were divided into the fifty percent highest scoring spellers (scores above .37) and the fifty percent lowest scoring spellers (scores below .37) based on the spelling performance scores on the pretest for word spelling. All students participated in the pretest, posttest, and all four training sessions.

Materials

Standardized word spelling test

General word spelling was measured by the standardized Dutch spelling-to-dictation test 'Schaal Vorderingen in Spellingvaardigheid' ([Scale Progression in Spelling Abilities] van den Bosch, Gillijns, Krom, & Moelands, 1991). This test contained 36 disyllabic or tri-syllabic words at the level of Grade 3. Students had to write down words that were orally presented to them. The lowest possible score was zero and the highest possible score was 36. All scores were transformed into proportions.

Word spelling on the pretest and posttest

Both the pretest and posttest contained 50 regularly spelled and 50 loan words. The pretest and the posttest contained the same words, although they were presented in a different order. Each test was administered in three sessions of 34, 33, and 33 words, respectively.

Regularly spelled words

The spelling of regularly spelled words was measured by a spelling-to-dictation test that was based on words used in the 'Schaal Vorderingen in Spelling-vaardigheid' ([Scale Progression in Spelling Abilities] van den Bosch et al., 1991) and on words used in the 'PI-dictee' ([PI-dictation] Geelhoed & Reitsma, 2004). Words that were used in the Standardized word spelling test were not used in this

test. All words could be spelled correctly when the spelling rules were used properly. The words contained no other spelling difficulties. The regularly spelled words that were used in the tests are presented in Appendix A. The lowest possible score was zero and the highest was 50.

Loan words
Loan words are words that cannot be spelled correctly by applying Dutch spelling rules. These words have to be known by heart or spelled by analogy to other words. The loan words that were used in this study were based on the loan words used in the study of Paffen and Bosman (2005). These loan words are presented in Appendix A. The lowest possible scores was zero and the highest possible score was 50.

Spelling consciousness
Spelling consciousness was measured by having students indicate whether they thought they were able to spell the particular word correctly or not. During the pretest and posttest, words were orally presented to the students. After a word was pronounced by the experimenter, the students first had to indicate whether they thought they were able to write the word correctly, by circling 'yes' or 'no'. Thereafter, they were allowed to write the word down. Students had to indicate this for all 100 words. The level of spelling consciousness was computed by counting the number of correct judgments. A judgment was correct when the student had circled 'yes' and also had written the word correctly, and when the student had circled 'no' and indeed wrote the word incorrectly. The lowest possible score was zero and the highest possible score was 50 for regularly spelled words and 50 for loan words.

Word spelling on the training sessions
The training consisted of four training sessions of 30 regular words each. Loan words were not trained. We selected the words based on the training dictations of the 'Schaal Vorderingen in Spellingvaardigheid' ([Scale Progression in Spelling Abilities] van den Bosch et al., 1991) and the 'PI-dictee ([PI-dictation] Geelhoed & Reitsma, 2004). The words used in the training were different from the words used in the pretest and posttest. All words could be spelled correctly when the spelling rules were used that the students had learned so far. The words contained no other spelling difficulties. All trained words are presented in Appendix B. For each session, the lowest possible score was zero and the highest score was 30.

Procedure
The test and training sessions were conducted by three Master students with the help of the first author of this paper. Each Master student tested and trained the

students at one school. The Master students received a thorough training and a manual in which the test and training procedures were described in detail. Prior to the first training session, the standardized word spelling test and the pretest for spelling were administered. The students were assigned to the three conditions and, as a result of the used matching procedure did not differ on general word spelling, spelling performance on the pretest, spelling consciousness on the pretest, age, and sex, all *F*'s < 1. Three weeks after the pretest, the training started. Students received one training session every week. The week after the fourth training session, the posttest was performed. The pretest and posttest were administered groupwise. The training sessions of the strategic-monitoring and self-monitoring conditions were also administered groupwise, whereas the training sessions of the strategy-instruction condition were administered individually. Table 1 presents the scores on the pretest.

Strategy-instruction condition

In this condition, students received strategy instruction in an individual setting. Each student was taken to a separate room in the school building. First, the experimenter explained that a spelling strategy would be taught, which would make it easier for the student to spell words correctly. After that, the experimenter explained the strategy and had the student practice with a particular word. The student was taught to divide each word into syllables and to name the rule(s) that could be applied to that particular syllable. After the student had correctly divided the word into syllables and applied all spelling rules, he or she was allowed to write the word down. When a student did not divide the words correctly or did not apply all rules correctly, the experimenter helped the student. When a word was written incorrectly, the experimenter helped the student to divide the word and apply the rules again, so that each word was written correctly. This was done for all 30 words.[2]

Strategic-monitoring condition

In this condition, the dictation task of each session was administered groupwise. After each dictation, each student was taken to a separate room in the school building. In the first session, the experimenter first explained that a spelling strategy would be taught, which would make it easier for the student to spell words correctly. After that, the experimenter explained that they were going to correct the dictation of the student. The student received his or her dictation back and a sheet with all correctly spelled words. When a word was written correctly,

2 In the strategy-instruction and strategic-monitoring condition, at the end of every session, the experimenter asked the student how he or she thought about the session. The experimenter just asked this question, but nothing was done with the answer of the student.

the student was allowed to indicate that the word was correct by putting a correct sign next to the word. When a word was written incorrectly, the student had to apply the strategy. The strategy was the same as in the strategy-instruction condition, but now it was used during the correction phase instead of the writing phase. This strategy was introduced with a practice word, just as in the strategy-instruction condition. After the student had corrected all words, the metacognitive questioning phase started, in which the experimenter asked a couple of questions to stimulate the student to think about his or her spelling. These questions were about the spelling process, the steps that had to be used to spell a word correctly, and the spelling rules that had to be applied. In the second, third, and fourth session, the procedure was exactly the same, however, there were also a couple of metacognitive questions asked before the students started to correct their dictation. The questions are presented in Appendix C.

Self-monitoring condition

In this condition, both the dictation session and the correction procedure were administered groupwise. The students within this condition were taken to a separate room in the school building. After the dictation task was accomplished, the students received a sheet with all correctly spelled words and they were instructed to correct their own work. The experimenter did not check whether or not the students properly corrected all words.

Table 1 Means and Standard Deviations of the Different Tests in the Three Conditions

	General word spelling	Pretest spelling performance	Pretest spelling consciousness
Condition			
Strategy-instruction (N = 28)			
Mean	.68	.35	.55
SD	.24	.18	.18
Strategic-monitoring (N = 30)			
Mean	.67	.37	.57
SD	.24	.19	.17
Self-monitoring (N = 30)			
Mean	.68	.37	.57
SD	.22	.18	.16

Results

First, the effect of the three training conditions with respect to spelling performance are presented. Secondly, the effects of the different training conditions with respect to spelling consciousness are discussed. For both analyses, we examined the effects of instruction on different types of words (regular vs. loan words), interventions (strategy instruction vs. strategic monitoring vs. self-monitoring), and spellers (low-skilled vs. high-skilled speller). We not only took into account the global measure of spelling consciousness (i.e. percentage of correct judgments), but also looked into more detail at the distribution of the judgments into the categories (i.e., 'yes-correct', 'yes-incorrect', 'no-correct', and 'no-incorrect').

For spelling performance and the global measure of spelling consciousness, we used difference scores between the pretest and posttest as an indicator for change in performance during the training. We chose difference scores to correct for pretest differences, albeit these were not significant (F's < 1). A Bonferroni correction was applied to all analyses.

Effects of the Three Training Conditions on Spelling Performance

To examine the effects of the three training conditions on spelling performance, a GLM procedure for repeated measures was conducted in a 2 (speller: low vs. high spelling-consciousness level) x 3 (intervention: strategy instruction vs. strategic monitoring vs. self-monitoring) x 2 (word: regular words vs. loan words) analysis on the progress between pretest and posttest. Speller and intervention were treated as between-subjects variables and word was treated as a within-subjects variable. The mean scores of the students in the three conditions are presented in Table 2.

GLM analyses for repeated measures indicated that neither the three-way interaction between speller, intervention, and word (F < 1), nor the two-way interactions between speller and intervention (F < 1), speller and word (F < 1), and intervention and word ($F(2, 82) = 2.31$, $p = .11$), or the main effects of speller (F < 1), and intervention (F < 1) reached significance. However, the main effect of word was significant ($F(1, 82) = 12.00$, $p < .001$, *partial* $\eta^2 = .13$), indicating that the progress was higher for regular words than for loan words ($p < .001$).

Thus, the progress in spelling performance did not differ between students of the three interventions. However, students in all three conditions made progress in spelling performance between pretest and posttest.[3] Neither type of word nor speller did affect this result. The progress was higher for regular words than for loan words. Spellers with a low spelling-consciousness level made the same amount

3 The spelling performance of students increased between pretest and posttest for students in the strategy-instruction ($t(28) = -9.31$, $p < .0001$), strategic-monitoring ($t(29) = -6.79$, $p < .0001$), and self-monitoring condition ($t(29) = -9.27$, $p < .0001$).

of progress in spelling performance scores between pretest and posttest than spellers with a high spelling-consciousness level.

Table 2 Spelling Performance Scores on the Different Words in the Three Conditions

		Low spelling-consciousness level			High spelling-consciousness level		
		Strategy instruction	*Strategic monitoring*	*Self-monitoring*	*Strategy instruction*	*Strategic monitoring*	*Self-monitoring*
Pretest							
All							
	M	.28	.26	.30	.44	.49	.44
	SD	.16	.12	.13	.18	.17	.20
Regular							
	M	.46	.42	.47	.66	.74	.65
	SD	.23	.18	.17	.19	.21	.25
Loan							
	M	.09	.10	.12	.22	.24	.22
	SD	.09	.09	.10	.19	.16	.18
Posttest							
All							
	M	.36	.34	.38	.52	.56	.53
	SD	.19	.11	.16	.16	.16	.20
Regular							
	M	.58	.53	.56	.79	.82	.75
	SD	.24	.14	.17	.12	.16	.22
Loan							
	M	.15	.14	.20	.26	.31	.32
	SD	.15	.11	.15	.21	.20	.21

Effects of the Three Training Conditions on Spelling Consciousness

Global measure of spelling consciousness

To examine the effects of the three training conditions on spelling consciousness, a GLM procedure for repeated measures was conducted in a 2 (speller: low-skilled vs. high-skilled speller) x 3 (intervention: strategy instruction vs. strategic monitoring vs. self-monitoring) x 2 (word: regular words vs. loan words) analysis on the progress between pretest and posttest. Speller and intervention were treated as between-subjects variables and word was treated as a within-subjects variable. The mean scores of the students in the three conditions are presented in Table 3.

GLM analyses for repeated measures indicated that neither the three-way interaction between speller, intervention, and word ($F < 1$), nor the two-way interactions between speller and intervention ($F < 1$), speller and word ($F < 1$), and

intervention and word ($F < 1$), or the main effects of speller ($F(1, 82) = 1.34$, $p = .25$), intervention ($F < 1$), and word ($F(1, 82) = 1.47$, $p = .23$) reached significance.

Table 3 Spelling Consciousness Scores on the Different Words in the Three Conditions

		Low-skilled speller			High-skilled speller		
		Strategy instruction	*Strategic monitoring*	*Self-monitoring*	*Strategy instruction*	*Strategic monitoring*	*Self-monitoring*
Pretest							
All							
	M	.47	.47	.48	.65	.66	.65
	SD	.19	.16	.16	.10	.12	.10
Regular							
	M	.47	.49	.47	.75	.79	.75
	SD	.13	.12	.11	.11	.12	.11
Loan							
	M	.47	.45	.49	.55	.53	.56
	SD	.27	.24	.24	.19	.17	.15
Posttest							
All							
	M	.56	.55	.52	.71	.69	.70
	SD	.17	.14	.12	.10	.09	.08
Regular							
	M	.56	.57	.53	.84	.81	.82
	SD	.13	.11	.11	.09	.10	.10
Loan							
	M	.56	.53	.52	.59	.55	.58
	SD	.24	.22	.17	.16	.14	.13

More specific measure of spelling consciousness

In the previous analysis, a global measure of spelling consciousness was used; the number of correct judgments (i.e., 'yes-correct' and 'no-incorrect'). However, to obtain a more detailed insight in the development in spelling consciousness, the effects of the different conditions on the exact judgments of the students were also examined. All four categories (i.e., 'yes-correct', 'yes-incorrect', 'no-correct', and 'no-incorrect') were taken into account. First the number of judgments in each category was computed, and thereafter, a GLM-procedure for repeated measures was performed in a 3 (intervention: strategy instruction vs. strategic monitoring vs. self-monitoring) x 2 (test: pretest vs. posttest) design for each category and for regular and loan words separately. Intervention was treated as a between-subjects variable and test was treated as a within-subjects variable. The percentages judgments in each category are presented in Table 4.

Table 4 Percentages Judgments in Each Category (i.e., 'yes-correct', 'yes-incorrect', 'no-correct', and 'no-incorrect')

			Yes		*No*	
			Regular	*Loan*	*Regular*	*Loan*
	Pretest					
		Mean	25.7	6.9	2.1	1.6
Correct		*SD*	12.3	6.9	3.5	2.2
	Posttest					
		Mean	30.7	9.6	2.3	1.3
		SD	11.6	8.5	3.8	2.1
	Pretest					
		Mean	16.8	23.2	5.0	18.4
Incorrect		*SD*	9.7	11.4	6.6	12.5
	Posttest					
		Mean	13.2	20.6	3.5	17.9
		SD	8.8	9.8	5.9	12.1

With respect to the category 'yes-correct' for regular words, neither the two-way interaction between intervention and test ($F < 1$), nor the main effect of intervention ($F < 1$) reached significance. However, the main effect of test was significant ($F(1, 85) = 67.54$, $p < .0001$, *partial* $\eta^2 = .44$). The number of judgments in this category was higher on the posttest than on the pretest.

With respect to the category 'yes-incorrect' for regular words, neither the two-way interaction between intervention and test ($F(2, 85) = 1.15$, $p = .32$), nor the main effect of intervention ($F < 1$) reached significance. However, the main effect of test was significant ($F(1, 85) = 40.99$, $p < .0001$, *partial* $\eta^2 = .33$). The number of judgments in this category was lower on the posttest than on the pretest.

With respect to the category 'no-incorrect' for regular words, neither the two-way interaction between intervention and test ($F < 1$), nor the main effect of intervention ($F < 1$) reached significance. However, the main effect of test was significant ($F(1, 85) = 13.48$, $p < .0001$, *partial* $\eta^2 = .14$). The number of judgments in this category was lower on the posttest than on the pretest.

With respect to the category 'no-correct' for regular words, neither the two-way interaction between intervention and test ($F < 1$), nor the main effects of intervention ($F < 1$) and test ($F < 1$) reached significance.

With respect to the category 'yes-correct' for loan words, neither the two-way interaction between intervention and test ($F < 1$), nor the main effect of intervention ($F < 1$) reached significance. However, the main effect of test was significant ($F(1, 85) = 62.42$, $p < .0001$, *partial* $\eta^2 = .42$). The number of judgments in this category was higher on the posttest than on the pretest.

With respect to the category 'yes-incorrect' for loan words, neither the two-way interaction between intervention and test ($F < 1$), nor the main effect of intervention ($F < 1$) reached significance. However, the main effect of test was significant ($F(1, 85) = 8.76$, $p < .001$, *partial* $\eta^2 = .09$). The number of judgments in this category was lower on the posttest than on the pretest.

With respect to the category 'no-incorrect' for loan words, neither the two-way interaction between intervention and test ($F(2, 85) = 1.08$, $p = .34$), nor the main effects of intervention ($F < 1$) and test ($F < 1$) reached significance.

With respect to the category 'no-correct' for loan words, the two-way interaction between intervention and test reached significance ($F(2, 85) = 3.95$, $p < .05$, *partial* $\eta^2 = .09$). Subsequent ANOVA's revealed that both on the pretest ($F < 1$) and posttest ($F(2, 85) = 2.92$, $p = .06$), there were no differences between the three interventions. Post-hoc *t* tests revealed that the number of judgments in this category did not differ between pretest and posttest for students in the strategy-instruction ($t(27) = 1.46$, $p = .16$) and strategic-monitoring condition ($t(29) = -1.49$, $p = .15$). However, for students in the self-monitoring condition, the number of judgments in this category was lower on the pretest than on the posttest ($t(29) = -2.23$, $p < .05$).

Thus, the progress in spelling consciousness did not differ between students of the three interventions. However, students in all three conditions made progress in spelling consciousness between pretest and posttest.[4] Neither type of word nor speller did affect this result. Moreover, low-skilled spellers made the same amount of progress as high-skilled spellers. To sum up, the effect of instruction on spelling consciousness was universal for type of words, interventions, and spellers. However, the way in which students assess their spelling changed between pretest and posttest. Students became more accurate in assessing which words (both regular and loan) they could spell correctly and made fewer errors in assessing which words they could not spell correctly. They made more 'yes-correct' and fewer 'yes-incorrect' judgments on the posttest than on the pretest. However, it became more difficult for them to accurately assess the regular words they could not spell correctly. They made fewer 'no-incorrect' judgments on the posttest than on the pretest. Note, however, that this might partly be due to the fact that students also spelled fewer words incorrectly on the posttest than on the pretest. Students in the self-monitoring condition made more 'no-correct' errors on loan words on the posttest than on the pretest.

4 The spelling consciousness of students increased between pretest and posttest for students in the strategy-instruction ($t(27) = -3.56$, $p < .001$), strategic-monitoring ($t(29) = -3.61$, $p < .001$), and self-monitoring condition ($t(29) = -2.80$, $p < .01$).

Discussion

In the present study, the role of instruction for spelling performance and spelling consciousness across words (regular words vs. loan words), interventions (strategy instruction vs. strategic monitoring vs. self-monitoring), and spellers (low-skilled speller vs. high-skilled speller) was examined. The effects of three instruction conditions in which metacognitive aspects were implemented in different extents were compared for third-grade students. In the strategy-instruction condition, students were taught a strategy that they had to apply before writing each word. The strategy involved the segmentation of words into syllables and the naming and application of the corresponding spelling rules. In this condition, metacognition was stimulated implicitly by offering students a structured way to think about their spelling before writing down a word. In the strategic-monitoring condition, students were taught the same strategy, but in this condition, students had to apply the strategy during the correction phase of their dictation. They had to apply the strategy to all incorrectly spelled words. Additionally, metacognition was stimulated more explicitly, by asking the students metacognitive questions. In the self-monitoring condition, students had to self-correct their spellings immediately after dictation. Metacognition was not stimulated explicitly, but thinking about the correctness of one's spellings, may stimulate metacognition implicitly. Spelling consciousness was measured by having students assess whether they thought they were able to write a word correctly before they had to write it down.

Words

The results showed that the effects of instruction were universal for both spelling performance and spelling consciousness with respect to type of words, interventions, and spellers. Our results for different types of words showed that the effects of the instruction conditions were the same for regular words as for loan words, both with respect to spelling performance and spelling consciousness. With regard to spelling consciousness, the progress in assessing regular words was equal to the progress in assessing loan words. However, with reference to spelling performance, the progress was higher for regular words than for loan words. This may be explained by the fact that during training, only regular words were used. Moreover, the strategy that was used in the strategy-instruction and strategic-monitoring condition could only be applied to regular words. Part of the strategy is to apply the previously learned spelling rules, whereas these Dutch spelling rules could not be applied to loan words.

Interventions

The results for different types of interventions showed the benefits of implicit and explicit metacognitive practice on both spelling performance and spelling consciousness, because all three training conditions had a positive effect. In the present study, no control group was included because Cordewener, Verhoeven, and Bosman (2014) had already shown that students in the strategy-instruction condition made more progress than students in the control group. Note that, students in the control group in the Cordewener et al. study received no feedback on their dictations, however, they did practice with the training words. Thus, the effects of the strategy-instruction condition might have been even stronger when compared with a control group that received no practice with the training words at all, but received only the classroom spelling-education program. With respect to spelling performance, the positive effects of the strategy-instruction and self-monitoring conditions in the present study were in line with results from Cordewener et al. Note that, there were differences between the conditions in the two studies. In the previous study, the same strategy had to be applied after dictation, whereas in the present study, the strategy had to be applied before writing down each word. Moreover, self-correction in the previous study took place not directly after dictation, whereas in the present study, it took place immediately after dictation. Most probably, these differences explain the stronger effects in the present study. Since the strategic-monitoring condition actually is a combination of self-correction and applying a strategy, it is perhaps not surprising that this condition was also effective. Moreover, the effects of strategy instruction that include syllable segmentation (Butyniec-Thomas & Woloshyn, 1997; Kernaghan & Woloshyn, 1995; Paffen & Bosman, 2005) and the application of spelling rules (Butyniec-Thomas & Woloshyn, 1997; Darch et al., 2006; Hilte & Reitsma, 2011; Kemper et al., 2012; Paffen & Bosman, 2005) were confirmed by previous research. The positive effects of self-monitoring were also in line with previous research (Grskovic & Belfoire, 1996; McGuffin et al., 1997; McNeish et al., 1992; Morton et al., 1998; Willemen et al., 2000, 2002; Wirtz et al., 1996). In the strategic-monitoring condition, these aspects were combined with metacognitive questioning, of which the positive effect on spelling performance was demonstrated by previous research (Jacobs, 2004).

With respect to spelling consciousness, the positive effects of the three training conditions are not in line with the previous study of Cordewener, Verhoeven, and Bosman (2014), in which strategy instruction and self-monitoring were not effective with respect to the improvement of spelling consciousness. Note that, as mentioned before, there were differences between the conditions in the two studies. In the previous study, the strategy had to be applied after writing the words, whereas in the present study they had to apply it before writing each word.

Moreover, in the present study, self-correction took place immediately after dictation, in contrast to the previous study. These differences most likely explain the stronger effects of the present study. These stronger effects are also in accordance with other studies. For example, the effect of the strategy-instruction condition on spelling consciousness was also established by Paffen and Bosman (2005). The strategic-monitoring condition is not only in line with the positive results of Paffen and Bosman (2005), but is also supported by the study of Jacobs (2004) in which they asked metacognitive questions concerning the way students thought about their spellings. The fact that self-correction is helpful for improving spelling consciousness conforms the work of Block and Peskowitz (1990) and Willemen et al. (2002), who also proved that self-correction leads to an increase in spelling consciousness. In all three conditions in the present study, students were allowed to inspect their spellings after dictation. This may have lead to an increase in spelling consciousness for all three conditions. After all, Block and Peskowitz (1990) showed that visual inspection after performing a dictation was effective for accurately estimating the correctness of one's spelling. The increase in spelling consciousness was also found by Paffen and Bosman (2005), who showed that only assessing the correctness of one's spelling during pretest and posttest led to an increase spelling consciousness.

Spellers

Our study also showed that, with respect to type of speller, the three training conditions were equally effective to improve spelling performance and spelling consciousness for both low- and high-skilled spellers. With regard to spelling performance, the fact that the three conditions were equally effective for both spellers with a low and with a high spelling-consciousness level, is in line with previous research of Willemen et al. (2000, 2002) and Paffen and Bosman (2005). Since both kind of spellers made the same amount of progress during training, spellers with a low spelling-consciousness level need more instruction and practice than spellers with a high spelling-consciousness level to catch up their delay. With respect to spelling consciousness, the intervention study of Paffen and Bosman (2005) confirmed the result that instruction was equally effective for both low- and high-skilled readers/spellers. In fact, their poor readers/spellers made the same amount of progress in spelling consciousness as the good readers/spellers, like in the present study.

To summarize, the results of the present study demonstrate the role of instruction for spelling performance and spelling consciousness across words, interventions, and spellers. They show the benefits of implementing metacognition in spelling education, both implicitly or more explicitly. Strategy instruction, strategic monitoring, and self-monitoring were all effective for both improving

spelling performance and spelling consciousness on both regular and loan words. The progress in spelling performance and spelling consciousness did not differ between low- and high-skilled spellers.

Practical Implications

The present study provides evidence for the importance of spelling instruction. Spelling instruction is universal with respect to words, interventions, and spellers. It is particularly interesting that both low- and high-skilled spellers profit from the same instruction, and even more important, they profit equally from instruction. Low-skilled spellers made an equal amount of progress as high-skilled spellers, both on spelling performance as on spelling consciousness. This means that, with respect to spelling, explicit instruction is effective, both for low- and high-skilled spellers as well as for spellers with a low and those with a high spelling-consciousness level. This is unlike research in other domains in which individual differences for implicit learning are almost absent, but highly present in explicit learning (Reber, Walkenfeld, & Hernstadt, 1991).

Thus, spelling instruction appears to be effective for different types of spellers, because all students profit in the same way, suggesting that spelling processes are quite similar for low- and high-skilled spellers and for spellers with low and high spelling-consciousness levels, provided that low-skilled spellers receive additional instruction and practice to catch up their delay.

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Appendix A. Words used in the pretest and posttest

Regularly spelled words	Loan words
brandnetels [nettles]	ruïne [ruins]
smokkelaars [smugglers]	explosie [explosion]
voetballer [soccer player]	theater [theatre]
stromen [streams]	lucifer [match]
schaduw [shadow]	fantastisch [fantastic]
sneeuwmannen [snowmen]	exotisch [exotic]
bericht [message]	orthodontist [orthodontist]
kastdeur [door of a closet]	bureau [desk]
beloning [reward]	chirurg [surgeon]
broodtrommel [bread box]	bibliotheek [library]
vogeltjes [little birds]	computer [computer]
verlegen [shy]	champignons [mushrooms]
koffertje [little suitcase]	plafond [ceiling]
vleesgerecht [meat-course]	maximum [maximum]
tomaten [tomatoes]	charmant [charming]
hoofdletter [capital]	ambulance [ambulance]
boterhammen [slices of bread]	spaghetti [spaghetti]
meeuwen [gulls]	illustratie [illustration]
krokodillen [crocodiles]	politie [police]
hardloper [runner]	cadeau [gift]
fluitketel [singing teakettle]	machinist [train driver]
getallen [numbers]	hobby [hobby]
oppassen [taking care]	centrum [centre]
brutaal [rude]	taxi [taxi]
schreeuw [scream]	hallucinatie [hallucination]
ongeveer [approximately]	cheque [cheque]
slaapzalen [dormitories]	liniaal [ruler]
fakkeloptocht [torch ceremony]	etalagepop [window dummy]
stoppelbaard [stubbly beard]	garagepoort [garage gate]
schommel [swing]	cirkel [circle]
vriendschap [friendship]	echo [echo]
verzameling [collection]	benzine [gasoline]
roeiers [rowers]	marathon [marathon]
zweefmolen [giant's stride]	apotheek [pharmacy]
kieuwen [gills]	punaise [thumbtack]
voorzitter [chairman]	romantisch [romantic]
toestemming [permission]	bioscoop [cinema]

weerverswachting [weather forecast]	meubilair [furniture]
bedankt [thanks]	centrifuge [centrifuge]
zelfbeheersing [self-control]	niveau [level]
bekeuring [penalty]	accommodatie [accommodation]
enkel [ankle]	architect [architect]
lawaai [noise]	journalist [journalist]
waterdruppels [drops of water]	uniform [uniform]
volwassenen [adults]	typen [to type]
oorverdovend [deafening]	export [export]
ademhaling [breath]	asperges [asparagus]
mooiste [prettiest]	expositie [exposition]
verfkwast [paintbrush]	emigratie [emigration]
gastspreker [guest speaker]	horloge [watch]

Appendix B. Words used in the training sessions

Session 1	Session 2
regen [rain]	bakker [baker]
schatkist [treasure chest]	tevreden [satisfied]
kralen [pellets]	zwaai [sway]
kreeft [lobster]	standhut [beach cabin]
avonturen [adventures]	middelen [means]
angst [fear]	opnieuw [again]
kassa [pay desk]	rugzakken [backpacks]
woord [word]	luchtballon [balloon]
vlokken [flakes]	bedlampje [bed lamp]
tovenaar [wizard]	kastelen [castles]
mond [mouth]	koektrommel [cookies box]
opener [opener]	kamerplanten [indoor plants]
pennen [pens]	broodplank [bread board]
schepen [ships]	bedden [beds]
handbal [handball]	verhalen [stories]
geweer [gun]	teleurstelling [disappointment]
paraplu [umbrella]	rondvaart [circular cruise]
oplichters [swindlers]	petten [caps]
appelstroop [apple treacle]	personen [people]
boerinnen [farmer's wives]	spannend [exciting]
vuist [fist]	ondeugend [naughty]
verschillen [differences]	kantoortje [small office]
stekelvarken [porcupine]	kannetje [cannikin]
spelletje [game]	beweging [movement]
sneeuwstorm [blizzard]	brillen [pairs of glasses]
broodkorst [bread crust]	garnalen [shrimps]
fietszadel [bike saddle]	geschreeuw [yelling]
geeuw [yawn]	gespetter [splash]
komkommer [cucumber]	vertrokken [departed]
vanzelfsprekend [obviously]	soeplepel [soup-ladle]

Session 3	Session 4
spuit [injection needle]	sprinkhanen [grasshoppers]
verkeerslicht [traffic-light]	veldmuis [field mouse]
ballonnen [balloons]	samenkomst [meeting]
hagelslag [chocolate sprinkles]	gehaktballen [meatballs]
kippenhok [hennery]	kantoren [offices]
brandstichter [arsonist]	kroketten [croquettes]
hobbelpaard [rocking horse]	schelpen [shells]
mededeling [announcement]	evenwicht [balance]
oktober [October]	geschrokken [frightened]
oppervlakte [surface]	bestemming [destination]
samen [together]	angstdromen [nightmares]
schatkamer [treasury chamber]	kennissen [acquaintances]
slaapkamer [bedroom]	slangen [snakes]
vergissing [mistake]	opvallend [remarkable]
aardbeving [earthquake]	tekeningen [drawings]
drinkwater [drinking water]	zangvogel [singing-bird]
gebaren [gestures]	voorstellingen [exhibitions]
kammetje [little brush]	voetstappen [footsteps]
melktand [primary tooth]	verkeerd [wrong]
nieuwsbrief [news letter]	brand [fire]
overdag [by day]	leeuwinnen [lionesses]
prinsessen [princesses]	ogenblikje [moment]
middelpunt [centre]	belangstelling [interest]
optocht [procession]	onverstoorbaar [imperturbable]
soldaten [soldiers]	ongelukken [accidents]
spoorloos [trackless]	verpleger [nurse]
spreeuwen [starlings]	uitstekend [excellent]
springstoffen [explosives]	vloeistoffen [fluids]
pudding [pudding]	woning [home]
toernooi [tournament]	vliegveld [airport]

Appendix C. Metacognitive questions

Questions before correcting the spelling-to-dictation task

1. Do you remember the things you had to think about while doing a spelling-to-dictation task?
2. Do you remember the steps you had to use to spell a word correctly?
3. How did it go this time?
4. Did you find difficult words?
    a. What did you do to spell them?
    b. What was easy and what was difficult?
    c. Can you point some words that were difficult for you?

Questions after correcting the spelling-to-dictation task

1. How do you think your spelling-to-dictation task went?
2. How do you think you can do it better next time?
3. What are the most difficult spelling rules for you?
4. How can you take care of applying these rules better next time?
5. Which steps can you take by spelling a word?
6. Do you think you are going to apply those steps when you are doing a dictation task next time?
7. Well are you going to try next time to use those steps? After the next spelling-to-dictation task, we will together correct your work again.

Chapter 8

General Discussion

General Discussion

This thesis focused on individual variation relating to precursors of spelling, spelling acquisition, and spelling instruction. To provide all children with effective spelling instruction, it first had to be examined whether the spelling of groups that vary in their spelling level is predicted by the same precursors (Chapter 2). Thereafter, individual variation in spelling acquisition could be examined by comparing the spelling errors of these groups of spellers (Chapters 3 and 4). Because the most effective spelling instruction may be different for various groups of spellers, we performed three studies on spelling instruction in which we took variation between spellers into account. We examined the effect of implicit and explicit instruction on the acquisition of spelling rules (Chapter 5), the effect of instruction on the acquisition of a structured approach to correct one's spelling and the effect of self-correction (Chapter 6), and the role of instruction across words, interventions, and spellers (Chapter 7). The effects on both spelling performance and spelling consciousness were investigated. Spelling performance was examined by having children spell words during a dictation task, and spelling consciousness was examined by having children assess whether they thought they were able to spell words correctly, before they were allowed to write each word down.

What Predicts Spelling Performance?

Examining the precursors of spelling performance is not only important for early detection of poor spellers, but also because the predictive value of precursors can provide implications for instruction or intervention. Investigating whether the spelling of various groups of spellers is predicted by the same precursors is necessary to provide all children with effective spelling instruction. The main goal of this thesis was variation in spelling. We, therefore, compared children with SLI with typically developing children, because children with SLI are at risk for developing a spelling delay. In other words, when precursors of spelling are different for children with SLI than for typically developing children, instruction for children with SLI may focus on other skills than instruction for typically developing children. For typically developing children, the precursor skills with the highest predictive value for early spelling acquisition are phonological awareness, letter knowledge, working memory, and rapid naming. However, the predictive value of these kindergarten precursors is generally limited to the early phase of formal spelling education (Caravolas et al., 2001; Lervåg & Hulme, 2010). That is, during the first one and a half year of spelling education, phonological awareness, letter knowledge (Caravolas et al., 2001; Lervåg & Hulme, 2010), working memory, and rapid naming (Lervåg & Hulme, 2010) predicted spelling acquisition

of young children, whereas the predictive value of these precursors had faded out when children were in second grade (Caravolas et al., 2001; Lervåg & Hulme, 2010). Only early spelling skills predicted further growth in spelling ability (Lervåg & Hulme, 2010).

The results of Chapter 2, concerning children with SLI, provided evidence for the limited predictive value of kindergarten precursors for the early spelling acquisition. Linguistic, phonological, orthographic, letter knowledge, memory, and nonverbal-reasoning skills were used to predict spelling acquisition at the end of first grade. Moreover, we included spelling skill at the middle of first grade as a predictor for spelling acquisition at the end of first grade. The results revealed that, although all precursor skills had some predictive value, only letter knowledge had a unique discriminative value. Moreover, letter knowledge at the beginning of first grade and spelling skill at the middle of first grade best discriminated between poor and good spellers at the end of first grade. On the basis of spelling skill at the middle of first grade, children that would be poor spellers at the end of first grade were all identified correctly. The fact that spelling skill at an earlier point in time was the best predictor for spelling acquisition later on, is in line with the results for typically developing children (Lervåg & Hulme, 2010). Thus, the results reveal that spelling acquisition was best predicted by spelling skill at an earlier point in time, both for typically developing children (Caravolas et al., 2001; Lervåg & Hulme, 2010) and for children with SLI (Chapter 2).

An important question resulting from the above is: Why do most children with SLI profit insufficiently from regular spelling education or why do some of them become poor spellers? One possible explanation is that children with SLI are delayed in their language abilities (e.g., McArthur & Bishop, 2001), which might make it more difficult for them to acquire spelling skills. More specifically, children with SLI could have difficulties with verbal-sequential processing, which is the processing of verbal information in a correct order (van Weerdenburg, Verhoeven, Bosman, & van Balkom, 2011). Verbal-sequential processing is important for spelling, since children have to memorize phonemes in the correct order and represent them with graphemes. Van Weerdenburg et al. showed that verbal-sequential processing was the strongest predictor for spelling in children with SLI. However, spelling education should not be postponed for children with SLI, because this will only increase their spelling delay. Moreover, there is evidence that when children are learning to spell, the quality of their speech and pronunciation may also increase (e.g., Ehri, 1984, 1985, 1987). When learning to spell, the letters in spellings may clarify what sounds are being heard in particular words, and what sounds have to be pronounced (Ehri, 1984, 1985). In speech, phonemes are difficult to detect, so having a visual representation of the phonemes may improve the pronunciation.

Another possible explanation lies in the quality of spelling education. Chapter 4 showed that children with a similar level at the start of formal instruction developed differently during first grade, as a result of distinct forms of spelling education. In Chapter 4, children with SLI from all three participating schools had the same letter-knowledge and word-spelling scores at the beginning and middle of first grade, whereas at the end of first grade, children at one school performed significantly lower than the children from the other two schools. Teachers of children with SLI may teach letter knowledge and spelling skills too slowly. This is unfortunate, because children with SLI already tend to be delayed in their early spelling skills, and they also receive less instruction and practice. Bosman (2007) showed that children from special education are able to reach spelling-performance scores above the national norm for regular education when they receive proper spelling education. Therefore, teachers of children with SLI are strongly recommended to intensify instruction and opportunities for practice.

Moreover, since early detection of poor spellers can occur rather accurately, it is also possible to implement early intervention immediately after spelling education has started. After all, spelling appears to be an autocatalytic process, in which poor spellers remain poor spellers when they do not receive intervention (Caravolas et al., 2001; Lervåg & Hulme, 2010). Intervention should be provided as early as possible, because it can prevent poor spellers from increasing their delay.

What do Spelling Errors Reveal in Typical and Atypical Learners?

Because spelling acquisition is best predicted by spelling skill at an earlier point in time for both typically developing children and children with SLI, one should focus on the process of spelling acquisition. Spelling acquisition can be investigated by examining the nature of spelling errors. We compared the spelling errors of typically developing children with those of children with SLI to examine whether there are only quantitative or also qualitative differences in spelling acquisition between the two groups. A quantitative difference would mean that children with SLI make more errors than typically developing children, whereas a qualitative difference would mean that children with SLI also make different spelling errors than typically developing children.

In Chapter 3, we compared the spelling of children with SLI with that of typically developing children by using Dutch norms and findings from previous research. The results indicated that, with respect to quantitative differences, children with SLI indeed had a delay in both letter knowledge and spelling skill. This delay persisted in first grade, but children were able to improve letter knowledge and spelling skills. However, with respect to qualitative differences, the spelling characteristics that affect the spelling of typically developing children are quite similar to those of children with SLI. Both typically developing children and

children with SLI found it easier to represent the initial grapheme than the final or medial grapheme in words, they were more successful in spelling shorter words than in spelling longer words, and they spelled more words correctly with a simple structure (i.e., CVC) than with a more complex structure (i.e., CVCC and CCVC).

In Chapter 4, we performed another study in which we compared the spelling acquisition of children with SLI with that of typically developing children, but now we also included a group of typically developing children into our study. The results of the study in Chapter 4 were in line with those of Chapter 3. Children with SLI do have a major quantitative delay in both letter knowledge and spelling skill during first grade, but their spelling is not qualitatively different from that of typically developing children. With respect to the quantitative delay in letter knowledge, almost 80 percent of the typically developing children knew all graphemes at the end of first grade, whereas only 20 percent of the children with SLI did. With respect to the delay in spelling, almost all typically developing children reached the criterion of writing 20 or more words correctly already at the middle of first grade, whereas most children with SLI did not even reach this criterion at the end of first grade. However, like in Chapter 3, children did make progress during first grade. They learned on average 12 graphemes during first grade and they wrote on average four more words correctly at the end of first grade than at the middle of first grade. Just like in Chapter 3, there were no qualitative differences between the spelling of children with SLI and typically developing children. When comparing the spelling errors, it appears that the influence of the characteristics type of grapheme, grapheme position, and word frequency were exactly the same for both groups of children. The direction of the effects of the characteristics word length and word structure were the same for both groups, but the effects were stronger for children with SLI than for typically developing children. More specifically, for word length, both groups were more accurate in the spelling of shorter words than in the spelling of longer words, but the difference between shorter and longer words was larger for children with SLI. For word structure, both groups scored higher on CVC- than on CVCC-words, but children with SLI also scored higher on CVC- than on CCVC-words, whereas typically developing children had the same scores on CVC- as on CCVC-words. This indicated that with respect to word length and word structure, the direction of the effects was the same for children with SLI as for typically developing children, but the effects were stronger for children with SLI. This could be explained by the fact that the schools for children with SLI teach spelling more slowly than the schools for typically developing children. Consequently, typically developing children have more experience with difficult words and their gap between the scores on easy and difficult words may be smaller than for children with SLI, who have only experience with easier words.

Thus, spelling errors reveal that children with SLI do have a major quantitative delay in both letter knowledge and spelling skill compared to typically developing children, but their spelling is not qualitatively different from that of typically developing children. Children with SLI make more spelling errors than typically developing children, but their spelling errors are not different from those of typically developing children. Although children at risk for spelling difficulties have a delay in spelling, the process of the acquisition of spelling knowledge is similar to that of typically developing children.

Various studies confirm the quantitative delay of children with SLI (Larkin, Williams, & Blaggan, 2013; Lewis, Freebairn, & Taylor, 2000; Nathan, Stackhouse, Goulandris, & Snowling, 2004; Nauclér, 2004; Snowling, Bishop, & Stothard, 2000; van Weerdenburg, Verhoeven, Bosman, & van Balkom, 2011). With respect to the qualitative delay, previous studies that compared the spellings of poor and good spellers with a typical language development confirm our results that the kind of spelling errors that poor spellers make are quite similar to that of good spellers (e.g., Bailet, 1990; Bosman & Van Orden, 1997; Holligan & Johnston, 1991; Holmes & Peper, 1977; Kamhi & Hinton, 2000; Moats, 1983; Newman, Fields, & Wright, 1993; Waters, Bruck, & Malus-Abramowitz, 1988).

We are aware of only a few studies that focused on a qualitative comparison of spelling between typically developing children and children with SLI. Larkin et al. (2013) and Silliman, Bahr, and Peters (2006) used a different method than we did to examine the differences between both groups. Larkin et al. assessed phonological accuracy of spelling errors of children with SLI of about 9;5 years of age, spelling-level matched, and chronological-age matched children. They examined the ability to spell non-words in a phonetically plausible manner, to apply orthographic rules to non-words, and to spell inflectional morphemes correctly (i.e., stems, -ed endings indicating the regular past tense, the progressive -ing morpheme, and the third person singular form -s). The overall findings for the application of orthographic rules and the spelling of inflectional morphemes are in line with our findings, indicating that children with SLI do have a delay in their spelling acquisition, but that their spelling acquisition is not really qualitatively different from that of typically developing children. However, with respect to the phonological accuracy of the spelling of non-words, their results showed that children with SLI were poorer than their spelling-level matched children. This was in line with the findings of Silliman et al., who revealed that 6 to 11 years old language impaired spellers did not really have a deviant spelling process, but that they had more problems with representing the basic phonological structure of more complex words (i.e., longer words or words with a more difficult linguistic structure) than their spelling-level matched. Moreover, language impaired spellers had more difficulties with inflectional morphemes (i.e., regular past tense,

irregular past tense, third person singular present tense, plurals, and present progressive tense).

The study of Larkin and Snowling (2008) also showed that the phonological accuracy of the spellings of children with language impairments of about 10;9 years old was lower than that of reading-level matched. This was in accordance with the study of Broc et al. (2013), who showed that children with SLI between 7 and 11 years of age made more phonologically unacceptable errors than typically developing children. However, in the study of Broc et al. there was no spelling-level matched control group. In the study of Larkin et al. (2013), there was a considerable amount of variability in the phonological accuracy of the spelling ability of children with SLI. Especially children with weak non-word repetition skills had difficulties using phonological spelling strategies (Larkin et al., 2013). Non-word repetition may assess the storage capacity of phonological information (Gathercole & Baddeley, 1990) and may be important in the learning of new words (Baddeley, 2003). However, future research is necessary to establish whether the spelling acquisition of children with SLI really differs from that of typically developing children.

One has to keep in mind that the age and language of the children and the way spelling errors were examined may have influenced the outcomes of the study. Previous research reveals that both poor and good spellers make mainly phonetically acceptable errors (e.g., Bosman & Van Orden, 1997; Bruck & Waters, 1988; Frith, 1980; Moats, 1983; Nelson, 1980; Pennington et al., 1986). However, in our studies in Chapters 3 and 4, we only used words that are consistent in their phoneme-to-grapheme correspondences, because we examined the very early spelling of Dutch children, and Dutch spelling education starts with consistent words. Therefore, we were not able to use a scoring system that examines the phonological accuracy of spelling errors.

Silliman et al. (2006) showed that children with language impairments are generally delayed in their spelling development rather than their spelling errors being of a qualitatively different nature from that of spelling-level matched children. However, their results revealed that the exact outcomes depend on the scoring system that was used to examine spelling errors. A scoring system for spelling errors frequently used in classrooms is scoring spellings according to a correct or incorrect standard. This spelling system provides only crude information about the underlying spelling problem of the speller. More informative scoring systems are systems that assess visual accuracy (i.e., percentages of bigrams and individual graphemes that are shared between the misspellings and the target words; Bruck & Waters, 1988; Lennox & Siegel, 1996), phonological accuracy (i.e., unconstrained systems that rely only on phonological accuracy, and constrained systems that rely also on orthographic positions; Bruck, Treiman, Caravolas,

Genesee, & Cassar, 1998; Bruck & Waters, 1988; Caravolas, Hulme, & Snowling, 2001; Cassar, Treiman, Moats, Pollo, & Kessler, 2005; Lennox & Siegel, 1996), or orthographic accuracy of spelling errors (i.e., spellings are orthographically acceptable when the sequence of graphemes is permissible in the particular language or orthographically unacceptable when the misspellings contain sequences of graphemes that are illegal or not occurring in the particular language; Bruck et al., 1998). Thus, future research should focus on scoring systems for spelling errors that are more useful for the comparison of groups of spellers and that are useful in the educational practice. For future research, it may also be interesting to examine individual spelling patterns of children, which may provide implications for both early detection of poor spellers and for spelling intervention.

What Fosters Learning to Spell?

Since early spelling skill is the best predictor of spelling acquisition for children with SLI and typically developing children and because children with SLI or children at risk for developing a spelling delay have a slower but similar spelling acquisition than typically developing children, we examined the consequences for the most effective and efficient instruction for low- and high-skilled spellers. We performed three studies in which we compared implicit and explicit instruction (Chapter 5), the effects of three feedback instruction conditions: application of a structured approach to correct one's spelling, self-correction, and no correction (Chapter 6), and the role of instruction across words, interventions, and spellers (Chapter 7).

Implicit learning refers to learning about the structure of stimuli without the intention to do so (Seger, 1994), whereas explicit learning is intentional and goals determine what will be learned (Cleeremans & Destrebecqz, 2005). After learning, spellers who have learned explicitly are usually capable of expressing the acquired knowledge structure. Learning to spell is an interesting domain to examine implicit and explicit learning. In the acquisition of spelling, spellers learn the underlying structures of words both implicitly during their spelling development, but also explicitly by spelling rules that are taught by teachers.

Learning to spell requires years of instruction and practice, which makes spelling an interesting domain to examine. The comparison between implicit and explicit instruction in this thesis (Chapter 5) revealed that first-grade spellers made more progress in the explicit than in the control condition, both for words containing a morphological and for words containing a phonological rule. However, spellers in the explicit condition did not make more progress than spellers in the implicit condition. Both low- and high-skilled spellers did not fully generalize their knowledge of the rules to new and pseudowords. Since explicit

instruction was not more effective than implicit instruction and since there was no full generalization, explicit instruction was less effective than we expected.

Two non-mutually exclusive explanations spring to mind. The first explanation is that the explicit-instruction training did not meet the five aspects of effective instruction described by Bosman (2004). The first aspect is that children have to write down words instead of having them use letter blocks or draw lines between graphemes. The second is writing down the entire word instead of only the target grapheme. The third is writing the word from memory while the target word is not visible. The fourth is providing children with direct feedback. In our study, all above described aspects were implemented, except for the fifth one, errorless learning. Errorless learning means that spellers have to practice with words until they reach the 100-percent correct criterion and are able to write all words correctly. In our study, six training sessions were not enough for children to reach the 100-percent correct criterion.

The absence of errorless learning may be the first explanation for the fact that explicit instruction was not as effective as we expected and for the lack of generalization to new and pseudowords. The second explanation may be that spellers did not master all prerequisites that were necessary to apply the spelling rules correctly. For example, one of the prerequisites for applying the morphological rule correctly is that spellers are able to transpose a word into its plural form. However, it appeared that spellers sometimes transposed words into incorrect plural forms. For example, the plural form of HERT [deer] is HERTEN, so HERT has to be written with a final T, whereas some children transposed HERT into the incorrect plural form HERDEN, and consequently wrote HERD with a final D instead of a T. Neijt and Schreuder (2007) found that spellers have a preference for the writing of D's over T's. Although they assessed this for D's and T's in medial positions, in contrast to final positions in our study, their findings may be related to ours.

One of their explanations, hypercorrection, may also be applicable to our findings. Teachers may more often correct the final T into a D than vice versa. This may cause children to choose a D when they are in doubt about whether to spell a T or a D. Thus, examining whether children master all prerequisites that are necessary for understanding the spelling instruction is a supplementary aspect that can be added to the five aspects of effective instruction of Bosman (2004).

With respect to variation in the influence of spelling instruction, the results revealed that the effects of the three conditions (i.e., implicit instruction, explicit instruction, and control condition) were the same for low- and high-skilled spellers. High-skilled spellers made more progress than low-skilled spellers on words containing the phonological rule, whereas low-skilled spellers made as much progress as high-skilled spellers on words containing the morphological rule. The lack of generalization was present for both low- and high-skilled spellers.

In Chapter 6, we compared the effects of instruction in three feedback conditions: A strategy-instruction condition in which spellers were taught a structured approach to spell words correctly, a self-correction condition in which spellers had to self-correct their work, and a no-correction condition in which spellers received no feedback. With respect to the immediate effects for spelling performance, the results revealed larger effects for third-grade spellers in the strategy-instruction condition than in the no-correction condition. With respect to the immediate effects for spelling consciousness, the strategy-instruction condition was more effective than the no-correction condition for loan words, because spellers in the no-correction condition had a decrease in spelling consciousness, whereas the spelling consciousness of spellers in the strategy-instruction condition remained stable. The positive effects of teaching children a structured approach to spell words are in line with previous research (Butyniec-Thomas & Woloshyn, 1997; Kernaghan & Woloshyn, 1995; Paffen & Bosman, 2005; Willemen et al., 2000, 2002). In the structured approach, spellers had to segment words into syllables and had to think of the rule(s) that had to be applied to each syllable. Both the use of syllable segmentation (Butyniec-Thomas & Woloshyn, 1997; Kernaghan & Woloshyn, 1995; Paffen & Bosman, 2005) and the teaching of spelling rules (Butyniec-Thomas & Woloshyn, 1997; Paffen & Bosman, 2005) have proven to be effective in other studies. A closer look at the spelling-consciousness scores revealed that spellers in the strategy-instruction condition were less inclined to overestimate their spellings compared to spellers in the self-correction condition. The finding that strategy-instruction is necessary for spellers to learn to indicate which words they are not able to spell, is in line with that of Paffen and Bosman (2005). When spellers know which words are difficult for them, they can pay extra attention to these words and they can work on the difficulties of these words.

However, four training sessions appeared not to be enough to reach sustained effects on spelling performance and spelling consciousness. A possible explanation for the fading out of the effects after the training may be the lack of errorless learning. As said, reaching the 100-percent correct criterion during training is an important aspect of instruction (Bosman, 2004). In the study of Chapter 6, spellers did not reach this criterion after four training sessions, so there was no errorless learning. Only four strategy-instruction sessions appeared to be insufficient for third graders to internalize the strategy and apply it after the training had stopped.

With respect to individual variation, the three conditions were equally effective for low- and high-skilled spellers. The finding that poor and good spellers profit from the same instruction is in line with previous research (Chapter 5; Paffen & Bosman, 2005; Willemen et al., 2000, 2002).

In Chapter 7, we adjusted the structured approach that was taught to third-grade spellers, by having them apply this approach before they wrote down a word rather than afterwards, and we added a condition in which both the approach and metacognitive questions were used to stimulate spellers to actively think about their spelling. We examined the role of instruction for spelling performance and spelling consciousness across these three types of interventions (i.e., strategy-instruction vs. strategic-monitoring vs. self-monitoring), but also across types of words (i.e., regular words vs. loan words) and types of spellers (i.e., low- vs. high-skilled spellers). The results revealed that the effect of instruction was universal across words, interventions, and spellers. In other words, the instruction conditions had the same effect on regular as on loan words, the progress was the same for spellers in all three conditions, and the effects and progress were the same for low- and high-skilled spellers.

Thus, to answer the question whether implicit or explicit spelling instruction is most effective, it appeared that explicit instruction was most effective. The studies in this thesis established that explicit-rule instruction and explicit instruction of a structured approach to spell words are effective ways to teach children how to spell. Moreover, implementing a metacognitive aspect to explicitly stimulate children to think about their spelling was also effective. However, this does not mean that children do not profit from implicit instruction. In contrast, our studies showed that implicit instruction of spelling rules, by the use of visual dictation, was useful for children to improve their spelling performance (Chapter 5). Moreover, children also make progress without receiving explicit instruction by the combination of making dictations and self-correction (Chapters 6 and 7), and even by assessing the correctness of their spellings before they write words down during dictation (Chapter 6).

As mentioned before, implicit instruction is not the same as implicit learning. When learning implicitly, children learn about the structure of stimuli without the intention to do so, and afterwards, most children cannot fully explain what they have learned (Seger, 1994). In our study, children in the implicit-instruction condition are aware that they are learning words, however, they are not aware that they are learning the underlying structure of words, since this structure was not explicitly taught to children. Therefore, we assume that in our studies, implicit instruction most likely led to implicit learning. Implicit learning is also apparent in other fields, like in knowledge about the physical world, the social world, and in language learning (Reber, 1993). Previous research already revealed that much of our spelling knowledge is implicitly acquired in the Dutch (van Doorn-van Eijsden, 1984), French (Pacton, Perruchet, Fayol, & Cleeremans, 2001), and English language (Bryant, Deacon, & Nunes, 2006; Bryant, Nunes, & Snaith, 2000; Kemp & Bryant, 2003; Steffler, 2001, 2004; Treiman, 1993). Our studies underline that implicit learning is apparent in the domain of spelling.

There are various ways to investigate implicit learning. We examined the effects of implicit spelling instruction in a natural setting. We trained spellers with extant words and we observed the posttest performance on both trained words and new words with the same word structures. A second way to examine implicit learning of spellers is by assessing their knowledge of existing underlying spelling rules by having them spell pseudowords (Bryant et al., 2000; Cassar & Treiman, 1997; Kemp & Bryant, 2003; Pacton, Fayol, & Perruchet, 2005; Pacton et al., 2001). It appears that spellers are using their implicit knowledge of underlying spelling rules during the spelling of pseudowords. A third way to examine implicit learning of spellers is to use artificial-grammar learning situations (Gomez, 1997; Perruchet & Pacteau, 1990; Reber, Walkenfeld, & Hernstadt, 1991). In these artificial grammar-learning tasks, spellers study letter strings that have no meaning and have an underlying grammar structure that is artificial. After the study phase, spellers are told that legality of the stimuli is rule governed, but they are not told what these rules are. In the posttest, spellers are presented with legal and illegal letter strings and they have to assess whether a string is legal or not according to the artificial-grammar structure. It appears that the spellers' performance during this posttest is usually above chance, which means that spellers do acquire implicit knowledge of the underlying artificial grammar, whereas they are not able to explicate these underlying rules (Gomez, 1997; Perruchet & Pacteau, 1990; Reber et al., 1991).

With respect to individual variation, the studies in this thesis showed that children who differ in their spelling level can profit from the same spelling instruction. Explicit instruction of a spelling rule or a structured approach to spell words appeared to be effective for both poor and good spellers. In previous research, more individual differences between children were found on explicit- than on implicit-learning tasks (Reber et al., 1991). Reber et al. showed that explicit learning was more strongly related to intelligence than implicit learning. However, in our studies, explicit instruction appeared to be most effective for both high- and low-skilled spellers. Note, however, that there is a difference between explicit instruction and explicit learning, but that explicit instruction most likely leads to explicit learning. Thus, it appears that, in the domain of spelling, explicit instruction does not lead to more individual variation than implicit instruction does. Our results are confirmed by the study of Hilte and Reitsma (2011), who also showed no differences between poor and good spellers in gains from implicit and explicit instruction. Our results are partly confirmed by the study of Kemper, Verhoeven, and Bosman (2012). They found no differences in explicit learning between poor and good spellers for the learning of an orthographic rule. However, they did find that good spellers profit more from explicit learning than poor spellers, since good spellers were better able to generalize their knowledge of the

morphological rule to new words. A possible explanation may be that Kemper et al. included spellers of special education as poor spellers, which may explain the larger difference between poor and good spellers. However, our results indicated that low- and high-skilled spellers profit from the same instruction, although low-skilled spellers need more instruction to catch up their delay.

As revealed in Chapter 5, instruction fails when spellers do not reach the prerequisites necessary for understanding the instruction and for applying the instructed rule or approach. An example concerning nouns, described above, was that spellers cannot apply the morphological rule for nouns with a final /t/-sound, when they do not know the plural form of the noun. Another example is the spelling of verbs. Spellers are not able to write verbs correctly, when they are not familiar with the different kind of verbs. In Dutch, both VERTELT and VERTELD are correct conjugated spellings of the verb VERTELLEN [to tell], depending on whether it is used as a third person singular verb or a past participle, respectively. In case of a third person singular verb, VERTEL is the stem and a T has to be added to make it HIJ VERTELT [he tells]. However, in case of a past participle, a D has to be added to the stem to make it HIJ HEEFT VERTELD [he has told]. Since spellers need all the prerequisites to be able to spell correctly, in the spelling education program, the various steps that have to be taken in the process of learning to spell, have to be accurately elaborated and presented in a structured way. For some steps, spellers have to acquire sound-letter knowledge (i.e., learning the phoneme-to-grapheme relations, learning which vowels are short and which are long), whereas for other steps, spellers have to learn spelling rules. Each step of the spelling process has to be taught in a fixed order. Therefore, teachers have to be familiar with the various steps and the order in which they have to be taken. For each step, it is desirable that spellers reach the 100 percent-correct criterion before they go to the next step. When these steps are presented in a structured way, it is easier for teachers to detect the particular caveats in the spelling development of a particular speller. They can use these steps to search for the cause of the underlying deficit in spelling knowledge of a particular child. The aspect of a structured spelling-education program is discussed more extensively in the paragraph 'What are the implications for educational practice?'

What is the Contribution of Spelling Consciousness?

To be able to spell correctly, spellers need to know which words are difficult for them and which words, or word parts, particular spelling rules or approaches have to be applied to, or have to be known by heart. This thinking about one's spelling and the ability to detect and correct one's spelling errors is called spelling consciousness (Block & Peskowitz, 1990; Bosman, 2004; Lull, 1917). Previous research already established that a higher level of spelling consciousness goes

along with a higher level of spelling performance (e.g., Deshler, Ferrel, & Kass, 1978; Jansen-Donderwinkel, Bosman, & van Hell, 2002; Willemen et al., 2002). The results of Chapters 6 and 7 underline this: Spelling consciousness was also related to spelling performance. High levels of spelling consciousness went along with high levels of spelling performance and vice versa. This suggests that spelling instruction should not only focus on spelling performance, but also on spelling consciousness.

The studies in Chapters 6 and 7 examined the effects of various instruction conditions on the level of spelling consciousness. The training conditions in Chapter 6 were not effective with respect to the improvement of spelling consciousness. However, the strategy-instruction condition was more effective than the no-correction condition for the assessment of loan words. Spellers in the strategy-instruction condition had to segment each word into syllables and had to think of the spelling rule(s) that could be applied to each syllable. The application of this structured approach may have triggered these spellers to think more about their spelling during the spelling process, and consequently, make them more able to accurately assess their spelling than spellers in the no-correction condition. More specific analyses showed that the application of the structured approach that was taught in the strategy-instruction condition made spellers less inclined to overestimate their spelling, whereas spellers in the self-correction condition had a bias towards 'yes-responses'. This is in line with the results of Paffen and Bosman (2005), who also found that only spellers who received a training became better at indicating which words they could not spell correctly.

Unlike Chapter 6, the instruction conditions used in Chapter 7 were all effective with respect to the improvement in spelling consciousness of third-grade spellers. Spellers in the strategy-instruction and strategic-monitoring condition had learned the same structured approach to spell words as was used in the strategy-instruction condition in Chapter 6. However, in the strategy-instruction condition in Chapter 7, spellers applied the structured approach before they wrote down the word, whereas in Chapter 6, they applied the approach after they had written down the words. Applying this approach prior to spelling the word may stimulate spellers to think about their spelling before they are going to spell the word, which may improve their ability to accurately assess their spelling before they write words down. In the strategic-monitoring condition, metacognitive questions were used to stimulate the spelling consciousness of spellers, which may have caused the improvement in spelling consciousness. In the self-monitoring condition, spellers were allowed to correct their spellings immediately after dictation, whereas spellers in the self-correction condition of Chapter 6 corrected their spelling not immediately after dictation. Direct self-correction appeared to be more effective to improve spelling consciousness. The strong effects of the

strategy-instruction (Paffen & Bosman, 2005), strategic-monitoring (Paffen & Bosman, 2005; Jacobs, 2004), and self-monitoring conditions (Block & Peskowitz, 1990; Willemen et al., 2002) on spelling consciousness are in line with previous research. In all three conditions, spellers were allowed to visually inspect their spellings after dictation, which appeared to be successful for accurately assessing the correctness of one's spellings (Block & Peskowitz, 1990). With respect to individual variation, the three instruction conditions were equally effective to improve spelling consciousness for both low- and high-skilled spellers. Moreover, low- and high-skilled spellers made the same amount of progress during the training, which was also found by Paffen and Bosman (2005).

Thus, the answer to the question what spelling consciousness contributes revealed that higher levels of spelling consciousness go along with higher levels of spelling performance. This indicates that spelling instruction should not only focus on spelling performance, but also on spelling consciousness. Spelling consciousness can be improved by having spellers assess whether they are able to correctly spell a word before they actually write the word, in combination with, a) teaching them a structured approach to spell words before they write them down, b) teaching them a structured approach to correct their spellings and asking them metacognitive questions, or c) having them self-correct their work immediately after dictation. Applying a structured approach may help spellers to avoid a bias towards 'yes-responses'.

What are the Implications for Educational Practice?

The studies described in this thesis revealed that kindergarten precursors only had limited predictive value for spelling acquisition, but that spelling acquisition was best predicted by letter knowledge and spelling level earlier in time. Children that appear to be poor in acquiring segmentation skills, letter knowledge or early spelling skills, should be detected as early as possible, since the earlier they receive extra instruction and opportunity to practice, the smaller their delay will be. Early detection is possible, since spelling appears to be an autocatalytic process. This means that poor spellers at the end of first grade can already be detected on basis of their spelling skills at the middle of first grade. These poor spellers or children with SLI need the same instruction as good spellers, they only need more instruction and practice. The implications for kindergarten teachers are that they should focus on practicing skills that are directly related to spelling, like segmentation and letter knowledge skills. Teachers of first grade should expand these skills by also focusing on the spelling of words.

Teachers of higher grades can use explicit instruction to teach spelling rules or to teach a structured approach to spell words that contain the application of various spelling rules. Teachers have to keep in mind the aspects important for

instruction, like: 1) writing words, 2) writing the entire words, 3) writing words from memory, 4) direct feedback, 5) errorless learning (Bosman, 2004), and 6) examining whether spellers master all prerequisites that are necessary to understand instruction and to apply a rule or an approach (Chapter 5). Examples of effective ways to improve spelling are teaching spellers a structured approach to spell words, asking them metacognitive questions, or having them self-correct their work directly after dictation. With respect to the teaching of a structured approach to spell words that contain various word categories, the approach can be applied both before and after the word is written down. It is preferable to apply the approach before the word is written down when it is not only intended to improve spelling performance, but also spelling consciousness. This approach can be combined by also asking the spellers metacognitive questions to stimulate their thinking about spelling. Self-correction directly after dictation is also effective to improve both spelling performance and spelling consciousness. It is recommended to focus on improving both spelling performance and spelling consciousness, since higher levels of spelling consciousness go along with higher levels of spelling performance. Implementing aspects of spelling consciousness within instruction does not demand extra time. It simply requires spellers to assess whether they are able to spell particular words before they write them down in combination with, for example, self-correction directly after dictation. This procedure already led to an improvement in both spelling performance and spelling consciousness. Children are in need of permanent instruction, because the positive effects of a short spelling-instruction training decline after the training has stopped.

The importance of providing spellers with a structured spelling-education program has been discussed above. A structured education program is not only important for the spelling of nouns, but also for the spelling of verbs. The curriculum for verb spelling has to be structured, because spellers first have to acquire grammatical categories before they are able to spell verbs correctly. They have to be familiar with the structure of sentences, the time in which sentences are written, verb conjugation, regular and irregular verbs, and the various concepts (e.g., verb, finite form, subject, past participle). After that, spellers have to be taught the various grammar rules important for verb spelling and they have to practice with these rules. In spite of the large amount of time spellers practice with verb spelling, the majority of spellers make many errors in the spelling of verbs. This indicates the significance of teaching the prerequisites and rules in a structured way.

An example of a structured spelling method is the relatively new Dutch method Staal ([Steel] Groot & Nederkoorn, 2013) in which both noun and verb spelling is taught in a structured way. When children are taught a particular phoneme, they simultaneously learn the category of this phoneme, so that, later on in their spelling development, they know which rules have to be applied for

each particular phoneme category. For example, children learn that the grapheme A belongs to the phoneme /ɑ/, and that this phoneme is a short vowel. Later on, when they learn that the word APPEL /ɑpəl/ [apple] can be segmented into /ɑ/ and /pəl/, they know that the /ɑ/ is a short vowel, and that the doubling rule has to be applied to short vowels at the end of a syllable, so that APPEL has to be spelled with a double P.

Spellers learn from the early phase of spelling, that they have to segment words into phonemes or syllables and have to think of the particular spelling rules that have to be applied to each phoneme or syllable. They learn that each word can consist of multiple parts, and that some parts can just be spelled by phoneme-to-grapheme conversions, whereas other parts require the application of rules that state how to spell them, and other parts have to be known by heart. Such a structured approach can help children to spell words in a structured way, which may stimulate them to think about their spelling during the spelling. The fact that such a structured approach can be used for various kinds of word parts, is also confirmed by the studies in this thesis that showed that a structured approach applied to regular words, was also effective for the spelling of loan words.

What are the Implications for Future Research?

A first direction for future research is the implementation of effective instruction in classroom situations instead of individual situations. The instruction studies in the present thesis involved training of individual spellers or training in smaller groups. However, in daily situation, teachers give instruction to individual spellers, but also to their entire class. Therefore, it is not only helpful to know which instruction is effective in one-to-one situations with, for example, poor spellers, but also which instruction is effective in classroom situations. Future research may focus on examining how the effective aspects of instruction that are found in the present thesis can be used in classroom situations. It not only has to be examined which instruction methods are effective, but also which methods are efficient and least time-consuming. Instruction to entire classes can be explicit and can focuses on the teaching of rules or the teaching of a structured approach to spell words.

A second direction for future research is the integration of the improvement of spelling consciousness in spelling instruction to entire classes. Teaching a structured approach to spell words, metacognitive questioning, and direct self-correction can be used to improve both spelling performance and spelling consciousness. The present thesis gives clear guidelines for future research, since the effective aspects of instruction for individual spellers can be used to set up effective instruction for classroom situations. Experienced teachers can receive an extensive training in applying these aspects of instruction and use them in

classroom situations. Researchers can observe the spelling lessons of the teachers and can provide them with feedback (i.e., for example with video recordings).

A third direction for future research is to examine the various sequential steps that have to be taken during the process of learning to spell. These steps depend on the structure of the particular language. A scheme that represents the steps can be used to elaborate a structured spelling-education program, since the steps have to be taught in a fixed order. It is desirable that spellers acquire the skills or knowledge belonging to a particular step before they go to the second step. When spellers have a deficit in their knowledge that belongs to a previous phase, this may cause problems in subsequent phases. Moreover, the scheme can be used by teachers to detect the cause of the underlying deficit in the spelling knowledge of a particular child. Teachers can intervene in an early phase by providing spellers with extra instruction and practice concerning their particular difficulties. Moreover, it can be investigated how to improve the ability of spellers to detect their spelling difficulties or deficits by themselves. Young spellers are not able to detect their difficulties by themselves, so they need their teachers' help for this. An overview of the steps that have to be taken to become a sufficient speller may help spellers to detect their difficulties themselves.

A fourth direction for future research is the examination of individual spelling processes. Some children profit from the regular spelling education and regular instruction, whereas other children need additional instruction and practice. It is interesting to examine the underlying characteristics of spellers who profit enough from regular instruction and those who need extra instruction. Furthermore, examining the individual developmental patterns is also interesting. Some children may have a slow start, but catch up their delay by themselves, whereas the delay of others may remain.

To summarize, future research may focus on how effective instruction focusing on spelling performance and spelling consciousness can be implemented in both one-to-one and classroom situations. Moreover, future research may also focus on the improvement of the spelling-education program for young spellers by developing an overview of the various steps that have to be taken to become a sufficient speller, by implementing these steps into a spelling-education program, and by improving the ability of (young) spellers to detect their spelling difficulties themselves. Finally, examining the characteristics and the developmental patterns of individual children that have difficulties with learning to spell and of children with a regular spelling development may be interesting for both academic research and educational practice.

Concluding Statement

The findings in this thesis strongly support the importance of spelling instruction. Apart from the finding that children with all kinds of spelling levels profit from spelling instruction, the studies also showed that these children can profit from the same type of instruction. In my opinion, this indicates that there is still plenty of room for improvement in the area of spelling education, since there are still many children for who learning to spell is a major challenge and since spelling can easily be improved by providing children with proper spelling instruction. I showed that children already improve in their spelling skill after a short training of only four sessions, which suggests that proper instruction can lead to major improvements in spelling skills of children. Research should therefore continue to examine the characteristics of proper spelling instruction, not only for one-to-one situations, but also for classroom situations. This could be especially beneficial since I have shown that all children can profit from the same type of instruction. One way to improve spelling education is to develop a spelling-education program in which the spelling curriculum is taught in a structured way. In short, in this spelling-education program, there should be guidelines for teachers that describe how the various sequential steps should be taught to spellers and which instructions should be used for each step. Implementing such a spelling-education program in educational practice, will hopefully lead to an improvement in the spelling abilities of children with all kinds of spelling levels.

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Nederlandse Samenvatting

Variatie in de Spellingvaardigheid van Kinderen: Voorspellers, Verwerving en Instructie

Wanneer kinderen vier, vijf of zes jaar oud zijn, maken ze bewust kennis met de wereld van de geschreven taal. In de jaren daarvoor kenden ze geschreven taal van boeken die werden voorgelezen en van letters en woorden die ze zijn tegengekomen in hun dagelijks leven. Vanaf het moment dat kinderen naar de basisschool gaan beginnen ze met het zelf produceren van letters, woorden, zinnen en uiteindelijk verhalen. Een kind zal ontdekken dat elk gesproken woord bestaat uit verschillende klanken, ofwel fonemen, en dat elk foneem gekoppeld kan worden aan een letterteken, ofwel grafeem. Een kind leert bijvoorbeeld dat het woord /stɛr/ opgedeeld kan worden in de fonemen /s/, /t/, /ɛ/ en /r/ en dat deze fonemen gekoppeld kunnen worden aan de grafemen S, T, E en R om zo het woord STER te schrijven. Het woord STER is klankzuiver omdat elk foneem maar gekoppeld kan worden aan één grafeem. Een kind zal echter ook niet-klankzuivere woorden gaan schrijven, zoals KIKKER en BOMEN. Veel van deze niet-klankzuivere woorden kunnen correct geschreven worden wanneer een kind geleerd heeft om fonologische, morfologische en/of orthografische regels toe te passen, wanneer woorden naar analogie met andere woorden worden geschreven of wanneer ze uit het hoofd geleerd worden. Om te leren bij welke woorden of delen van woorden bepaalde spellingregels of spellingstrategieën gebruikt moeten worden, of om te weten welke woorden uit het hoofd geleerd moeten worden, moeten kinderen actief nadenken over hun spelling. Dit denken en reflecteren over het eigen spellingproces en de vaardigheid om de eigen spelfouten op te merken en te corrigeren wordt spellingbewustzijn genoemd. Uit eerder onderzoek is gebleken dat er veel variatie in de spellingvaardigheden van kinderen kan worden waargenomen. In dit proefschrift is daarom de variatie in spellingvaardigheid onderzocht met betrekking tot de voorspellers van spelling (Deel 1: Hoofdstuk 2), de verwerving van spelling (Deel 2: Hoofdstukken 3 en 4) en spellinginstructie (Deel 3: Hoofdstukken 5, 6 en 7). Het uiteindelijke doel van het onderzoek is om een bijdrage te leveren aan de verbetering van het spellingonderwijs, met als belangrijkste doelgroep de kinderen die moeite hebben met het leren spellen.

Deel 1 Voorspellers van Spelling

In Hoofdstuk 2 zijn voorspellers van spelling vergeleken voor kinderen met ernstige spraak- en taalmoeilijkheden (ESM) en kinderen zonder taalproblemen. Kinderen met ESM hebben een achterstand in hun taalontwikkeling die niet te wijten is aan een beperkte non-verbale intelligentie, een visuele of auditieve beperking, neurologische, fysieke, emotionele of sociale problemen of onvoldoende mogelijkheden om taalvaardigheden te verwerven. Ze kunnen moeilijkheden

hebben met het begrijpen of het uiten van taal op het gebied van fonologie, morfologie, syntaxis, semantiek en/of pragmatiek. Als gevolg van hun taalmoeilijkheden hebben kinderen met ESM een verhoogd risico op het ontwikkelen van spellingproblemen. Vanwege het verhoogde risico op spellingproblemen is ervoor gekozen om de spellingontwikkeling van deze kinderen te vergelijken met de ontwikkeling van kinderen zonder taalproblemen.

Bij 58 kleuters met ESM uit groep 2 zijn gedurende anderhalf jaar verschillende testen afgenomen op het gebied van linguïstische, fonologische, orthografische, letterkennis-, geheugen-, non-verbaal redeneer- en spellingvaardigheden om na te gaan wat de beste voorspellers zijn voor spellingvaardigheid aan het einde van groep 3. De resultaten laten zien dat spellingproblemen aan het einde van groep 3 het beste voorspeld kunnen worden door letterkennis aan het begin van groep 3 en spellingvaardigheid in het midden van groep 3. Op basis van de spellingvaardigheid in het midden van groep 3 kunnen kinderen met spellingproblemen aan het einde van groep 3 met 100% nauwkeurigheid worden geïdentificeerd. Op basis van letterkennis aan het begin van groep 3 en spellingvaardigheid in het midden van groep 3, kunnen met 91% nauwkeurigheid de kinderen geselecteerd worden die geen spellingproblemen zullen hebben aan het einde van groep 3. Deze resultaten tonen aan dat spelling een autokatalytisch proces is: zonder interventie zijn zwakke spellers in het midden van groep 3 nog steeds zwakke spellers aan het einde van groep 3 en zijn goede spellers in het midden van groep 3 nog steeds goede spellers aan het einde van groep 3. In de literatuur beschreven onderzoeken hebben dezelfde resultaten gevonden bij kinderen zonder taalproblemen. Met betrekking tot variatie in spellingvaardigheid mogen we daarom aannemen dat voor zowel kinderen zonder taalproblemen als voor kinderen met ESM spellingvaardigheid op een eerder moment gemeten de beste voorspeller is voor latere spellingproblemen. Voor de praktijk betekent dit dat leerkrachten zich het beste kunnen richten op auditieve analyse, letterkennis en de spellingvaardigheid zelf.

Deel 2 Verwerving van Spelling

De studie in Deel 1 (Hoofdstuk 2) toont aan dat de spellingvaardigheid het beste voorspeld kan worden door op een eerder moment de spellingvaardigheid zelf te meten. Daarom is in Deel 2 (Hoofdstukken 3 en 4) verder onderzoek verricht naar de verwerving van die spellingvaardigheid. In Hoofdstuk 3 zijn de snelheid, aard en kennisgeneralisatie van de spellingverwerving van 59 kinderen met ESM uit groep 3 onderzocht en vergeleken met normen van en literatuur over kinderen zonder taalproblemen. De resultaten met betrekking tot de snelheid waarmee kinderen met ESM letterkennis en spellingvaardigheden verwerven, tonen aan dat deze kinderen aan het einde van groep 3 een achterstand hebben ten opzichte van kinderen zonder taalproblemen, zowel op het gebied van letterkennis als op

het gebied van spellingvaardigheden. De achterstand in spellingvaardigheden neemt iets af tussen het midden en het einde van groep 3. De resultaten met betrekking tot de aard van de spellingverwerving tonen echter aan dat de kenmerken van de spelling van kinderen met ESM niet afwijken van die van kinderen zonder taalproblemen. Beide groepen kinderen maken minder fouten in het schrijven van het begingrafeem dan het eind- of middengrafeem (grafeempositie), maken minder fouten in het schrijven van korte dan van lange woorden (aantal grafemen) en schrijven meer woorden correct met een simpele woordstructuur (MKM-woorden[1]) dan met een moeilijkere woordstructuur (MKMM- en MMKM-woorden; woordstructuur). Voor het kenmerk 'type grafeem' is gevonden dat kinderen met ESM evenveel fouten maken in klinkers als in medeklinkers, terwijl uit de literatuur voor kinderen zonder taalproblemen naar voren komt dat kinderen minder fouten maken in het schrijven van medeklinkers dan van klinkers. Dit verschil kan hoogstwaarschijnlijk verklaard worden door de woorden die gebruikt zijn in het dictee en het gebruikte scoringssysteem. De resultaten met betrekking tot kennisgeneralisatie tonen aan dat wanneer kinderen een letter beheersen, ze deze meestal ook toepassen in het schrijven van een woord waarin die letter voorkomt. Kinderen generaliseren hun kennis van letters naar het spellen van woorden, ondanks het feit dat een foneem anders klinkt in de context van een woord dan in de losse uitspraak. Deze kennisgeneralisatie is echter niet volledig consistent, want in 20 procent van de gevallen kent een kind een los foneem wel, maar schrijft het dit niet goed in de context van een woord of kent het kind een los foneem niet, maar schrijft het dit wel goed in de context van een woord.

In Hoofdstuk 4 is opnieuw een kwantitatieve en kwalitatieve vergelijking gemaakt tussen de spellingverwerving van kinderen met ESM en kinderen zonder taalproblemen. Om een betere vergelijking te kunnen maken is in deze studie naast de groep van 59 kinderen met ESM eveneens een controlegroep van 39 kinderen zonder taalproblemen meegenomen. De bevindingen uit deze studie ondersteunen de conclusies van Hoofdstuk 3, namelijk dat er een kwantitatief verschil is in de spellingverwerving van beide groepen kinderen uit groep 3, maar dat er geen kwalitatief verschil is. Er mag van een kwantitatief verschil gesproken worden omdat kinderen met ESM ten opzichte van kinderen zonder taalproblemen gedurende heel groep 3 een achterstand hebben, zowel op letterkennis als op spellingvaardigheid. Bijna 80 procent van de kinderen zonder taalproblemen kent aan het einde van groep 3 alle grafemen, ten opzichte van maar 20 procent van de kinderen met ESM. Bijna alle kinderen zonder taalproblemen schrijven in het midden van groep 3 20 woorden of meer correct, terwijl de meeste kinderen met ESM dit criterium nog niet halen aan het einde van groep 3 (61 procent). Ondanks

1 De M staat voor medeklinker en de K voor klinker. Het woord KAT is een voorbeeld van een MKM-woord.

hun achterstand leren kinderen met ESM gemiddeld 12 grafemen tijdens groep 3 en schrijven ze gemiddeld 4 woorden meer correct aan het einde dan in het midden van groep 3.

Er is geen kwalitatief verschil omdat de invloed van de kenmerken 'type grafeem', 'grafeempositie' en 'woordfrequentie' hetzelfde is voor beide groepen kinderen. Kinderen uit beide groepen maken bijvoorbeeld evenveel fouten in klinkers als in medeklinkers (type grafeem). Deze bevinding ondersteunt de verklaring gegeven in Hoofdstuk 3, namelijk dat het feit dat kinderen evenveel fouten maken in klinkers als in medeklinkers toegeschreven kan worden aan de woorden die gebruikt zijn in het dictee en het scoringssysteem dat gebruikt is. Daarnaast schrijven kinderen uit beide groepen begin-, midden- en eindgrafemen evengoed (grafeempositie), schrijven ze laag-, gemiddeld- en hoogfrequente woorden evengoed (woordfrequentie) en schrijven ze meer korte dan lange woorden goed (woordlengte). Dit laatste effect is wel sterker voor kinderen met ESM dan voor kinderen zonder taalproblemen. Het effect van woordstructuur verschilt iets tussen beide groepen; beide groepen schrijven meer MKM- dan MK*M*M-woorden goed, maar kinderen met ESM schrijven ook meer MKM- dan M*M*KM-woorden goed. Een waarschijnlijke verklaring is dat kinderen met ESM door hun achterstand minder geoefend hebben met M*M*KM-woorden dan kinderen zonder taalproblemen. Op basis van de studies beschreven in Deel 2 (Hoofdstukken 3 en 4) mag geconcludeerd worden dat kinderen met ESM een achterstand hebben in hun letterkennis- en spellingverwerving ten opzichte van kinderen zonder taalproblemen, maar dat de aard van de spellingverwerving hetzelfde verloopt voor beide groepen kinderen.

Deel 3 Spellinginstructie

Aangezien spelling het beste voorspeld kan worden door de spellingvaardigheid zelf te toetsen op een eerder moment (Deel 1: Hoofdstuk 2) en de spellingverwerving in verschillende groepen spellers kwalitatief hetzelfde verloopt (Deel 2: Hoofdstukken 3 en 4), wordt in Deel 3 (Hoofdstukken 5, 6 en 7) van dit proefschrift onderzocht hoe de spellingvaardigheid het beste verbeterd kan worden voor zowel zwakke als goede spellers. Onderzocht zijn achtereenvolgens: (i) de invloed van impliciete en expliciete instructie op de verwerving van spellingregels (Hoofdstuk 5), (ii) het effect van instructie op het verwerven van een gestructureerde aanpak om de eigen spelling na te kijken en het effect van zelfcorrectie (Hoofdstuk 6) en (iii) de rol van instructie voor het type woord, het type interventie en het type speller (Hoofdstuk 7). Omdat de meest effectieve spellinginstructie verschillend zou kunnen zijn voor verschillende groepen spellers, is er in alle drie de hoofdstukken nagegaan of de spellinginstructie hetzelfde effect heeft op goede als op zwakke spellers. In de laatste twee hoofdstukken is niet alleen het effect van spelling-

instructie op spellingvaardigheid maar ook op spellingbewustzijn onderzocht. Spellingbewustzijn is gemeten door de kinderen voor het schrijven van elk woord een rondje te laten zetten om 'ja' wanneer ze dachten het woord goed te kunnen schrijven en om 'nee' wanneer ze dachten het woord niet goed te kunnen schrijven.

In Hoofdstuk 5 is de invloed van impliciete en expliciete spellinginstructie vergeleken voor het aanleren van een morfologische[2] en een fonologische[3] spellingregel. Een groep van 193 kinderen uit groep 3 van het reguliere basisonderwijs is verdeeld over een impliciete instructie-, expliciete instructie- en een controleconditie. De kinderen in de impliciete instructieconditie kregen tijdens de sessies woorden aangeleerd met behulp van visueel dictee; ze bestudeerden elk woord gedurende drie seconden, schreven het woord daarna uit het hoofd op en keken vervolgens na of ze het woord correct geschreven hadden en verbeterden het indien nodig. De spellingregel werd in deze conditie niet uitgelegd. De kinderen in de expliciete instructieconditie kregen expliciet de spellingregel uitgelegd en oefenden in de sessies met het toepassen van de regel. Daarnaast was er een controleconditie die geen trainingsessies kreeg. Uit de bevindingen voor de instructie van beide spellingregels blijkt dat kinderen in de expliciete instructieconditie meer vorderingen maken dan de kinderen in de controleconditie. Spellers in de expliciete conditie maken niet meer vorderingen dan spellers in de impliciete conditie, maar scoren op de nameting wel hoger op pseudowoorden, ofwel niet-bestaande woorden, dan spellers in de impliciete conditie. De effecten van de drie condities zijn hetzelfde voor goede als voor zwakke spellers (goede spellers gaan wel meer vooruit op woorden met de fonologische regel). Zowel goede als zwakke spellers uit de impliciete en expliciete instructieconditie generaliseren hun kennis van de regels niet volledig naar nieuwe en pseudowoorden.

Het feit dat expliciete instructie niet zo effectief blijkt te zijn als we verwacht hadden, kan verschillende verklaringen hebben. Ten eerste blijken zes trainingsessies per spellingregel niet genoeg voor kinderen om het 100-procent correct criterium te behalen, wat betekent dat kinderen de regel aan het einde van de training nog niet volledig beheersen. Ten tweede beheersten niet alle kinderen de voorwaarden om de spellingregels correct toe te kunnen passen. Zo waren er kinderen die niet in staat waren om alle woorden in het juiste meervoud te vervoegen, waardoor ze het woord HERT als HERDEN vervoegden en vervolgens het woord incorrect schreven.

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2 De morfologische regel is de verlengingsregel voor zelfstandig naamwoorden die eindigen op een /t/-klank, die afhankelijk van het meervoud geschreven moeten worden met en D of een T. Het woord KAT wordt met een T geschreven omdat het meervoud KATTEN is (waarbij een /t/-klank hoorbaar is), terwijl HOND met een D geschreven wordt omdat het meervoud HONDEN is (waarbij een /d/-klank hoorbaar is).

3 De fonologische regel is de regel voor woorden met -AAI, -OOI, of -OEI, waarin een /j/-klank hoorbaar is, maar een I geschreven wordt.

Na het vergelijken van impliciete en expliciete instructie van een regel in Hoofdstuk 5, zijn in Hoofdstuk 6 de effecten van instructie in drie feedbackcondities vergeleken op zowel spellingvaardigheid als spellingbewustzijn. Een groep van 72 kinderen uit groep 5 van het reguliere basisonderwijs werd verdeeld over een strategie-instructieconditie, zelfcorrectie conditie en een controleconditie. De kinderen in de strategie-instructieconditie kregen een aanpak aangeleerd waarmee ze hun geschreven woorden op een gestructureerde manier konden nakijken. Ze leerden om elk woord eerst op te delen in klankgroepen en vervolgens per klankgroep de regel(s) te benoemen en toe te passen die bij die klankgroep gebruikt konden worden. De kinderen in de zelfcorrectie conditie keken hun geschreven woorden na het dictee zelfstandig na met behulp van een antwoordblad. De kinderen in de controleconditie kregen hun werk na het dictee niet meer terug. Uit de bevindingen blijkt dat strategie-instructie effectiever is voor het verbeteren van de spellingvaardigheden dan het niet nakijken van het dictee. Na afloop van de training vervagen deze effecten echter, wat aangeeft dat vier trainingsessies niet voldoende is om langetermijneffecten te bereiken. Dit kan mogelijk ook verklaard worden doordat kinderen niet het 100-procent correct criterium bereikt hebben tijdens de training. De bevindingen voor spellingbewustzijn tonen aan dat strategie-instructie effectiever is dan het niet ontvangen van feedback, aangezien kinderen die strategie-instructie kregen stabiel blijven in hun spellingbewustzijn-scores op leenwoorden[4], terwijl kinderen die geen feedback hebben gekregen achteruit gaan in deze scores. Na afloop van de training verdwijnen ook deze effecten. Met betrekking tot de variatie in spelling blijkt verder dat de meest effectieve instructie hetzelfde is voor goede als voor zwakke spellers.

Na het vergelijken van impliciete en expliciete instructie van een regel (Hoofdstuk 5) en de effecten van instructie in drie feedbackcondities (Hoofdstuk 6), is in Hoofdstuk 7 de rol van instructie onderzocht voor het type woord (leenwoorden vs. regelwoorden), het type interventie (strategie-instructie vs. strategie-monitoring vs. zelf-monitoring) en het type speller (goede spellers vs. zwakke spellers) voor zowel de spellingvaardigheid als het spellingbewustzijn. Op basis van de positieve effecten van het aanleren van de strategie in Hoofdstuk 6, zijn we in Hoofdstuk 7 verder gegaan met het aanleren van een zo effectief mogelijke strategie om woorden te spellen. Een groep van 88 kinderen uit groep 5 van het reguliere basisonderwijs is verdeeld over een strategie-instructie, strategie-monitoring en een zelf-monitoringconditie. Voor de strategie-instructieconditie in Hoofdstuk 7 hebben we de strategie uit Hoofdstuk 6 aangepast door de kinderen de gestructureerde aanpak toe te laten passen voordat ze een woord schreven in

4 Leenwoorden vinden hun oorsprong in een andere taal en zijn daarom niet altijd correct te schrijven wanneer de Nederlandse spellingregels worden toegepast. Regelwoorden daarentegen kunnen correct geschreven worden wanneer de Nederlandse spellingregels worden toegepast.

plaats van nadat ze een woord geschreven hadden. Voor de strategie-monitoring-conditie hebben we de strategie wel achteraf toe laten passen op de fout geschreven woorden en hebben we daarnaast ook metacognitieve vragen[5] gesteld om het spellingbewustzijn en de spellingvaardigheid te stimuleren. In de zelf-monitoring-conditie pasten de kinderen geen strategie toe, maar mochten ze direct na het dictee hun woorden zelf nakijken met behulp van een antwoordblad. De bevindingen tonen aan dat het effect van instructie universeel is voor type woord, type interventie en type speller voor zowel spellingvaardigheid als spellingbewustzijn. In andere woorden: (i) de instructiecondities hebben hetzelfde effect op regelwoorden als op leenwoorden[6], (ii) de vooruitgang is hetzelfde voor spellers in de strategie-instructieconditie, strategie-monitoringconditie, als voor spellers in de zelf-monitoringconditie en (iii) de effecten en de vooruitgang zijn hetzelfde voor goede als voor zwakke spellers.

Conclusies

Op basis van de bevindingen in dit proefschrift mogen we met betrekking tot variatie in spellingvaardigheid aannemen dat voor verschillende groepen kinderen spellingvaardigheid op een eerder moment gemeten de beste voorspeller is voor latere spellingproblemen (Hoofdstuk 2). Leerkrachten kunnen zich daarom het beste richten op letterkennis, auditieve analyse en de spellingvaardigheid zelf. Wanneer de spellingvaardigheid verder onderzocht wordt, blijkt dat kinderen met taalproblemen wel een achterstand hebben in hun spellingverwerving ten opzichte van kinderen zonder taalproblemen, maar dat de spellingverwerving in beide groepen kwalitatief gezien hetzelfde verloopt (Hoofdstukken 3 en 4). Dit betekent dat leerkrachten met zwakke spellers, of kinderen met taalproblemen, dezelfde vaardigheden kunnen oefenen als met goede spellers, of kinderen zonder taalproblemen. Dat de spellingvaardigheid sterk afhankelijk is van de instructie die gegeven wordt, blijkt ook uit de bevindingen beschreven in dit proefschrift in de Hoofdstukken 5, 6 en 7. Een korte training bestaande uit vier of zes sessies zorgt al voor een grote vooruitgang bij jonge spellers, zowel in spellingvaardigheid als in spellingbewustzijn. Er kan zowel gebruik gemaakt worden van expliciete als van impliciete instructie. Voorbeelden van effectieve vormen van expliciete instructie zijn de expliciete instructie van een spellingregel (Hoofdstuk 5) of de expliciete instructie van een strategie om woorden op een gestructureerde manier te spellen (Hoofdstukken 6 en 7). Een voorbeeld van een effectieve strategie is het

5 Voorbeelden van metacognitieve vragen zijn: 'Hoe vind je dat je dit dictee hebt gemaakt?', 'Hoe denk je dat je het de volgende keer nog beter kan doen?', 'Wat zijn jouw moeilijke regels?', 'Hoe ga je er de volgende keer voor zorgen dat je nog beter aan je moeilijke regels denkt?' en 'Welke stappen ga je nemen bij het schrijven van een woord?'.

6 De vooruitgang in spellingvaardigheid was wel groter op regelwoorden dan op leenwoorden.

opdelen van een woord in klankgroepen en per klankgroep de bijbehorende spellingregel(s) te benoemen en toe te passen. Deze strategie kan zowel voor als na het spellen van een woord worden toegepast en kan zelfs in combinatie met het gebruik van metacognitieve vragen worden gebruikt. Effectieve vormen van impliciete instructie zijn het gebruik van visueel dictee (Hoofdstuk 5) en directe zelfcorrectie (Hoofdstuk 7).

Daarnaast komt uit de bevindingen in dit proefschrift het belang van het focussen op spellingbewustzijn naar voren (Hoofdstukken 6 en 7). Een hogere mate van spellingbewustzijn gaat samen met een hogere mate van spellingvaardigheden en daarom is het belangrijk dat hier ook aandacht aan wordt besteed in het spellingonderwijs. Het spellingbewustzijn kan op een vrij eenvoudige en niet-tijdrovende manier gestimuleerd worden door spellers voor het spellen van een woord aan te laten geven of ze denken het woord correct te kunnen spellen, in combinatie met (i) het laten toepassen van een strategie voordat ze een woord spellen, (ii) het aanleren van deze strategie om woorden na te kijken in combinatie met het stellen van metacognitieve vragen, of (iii) het laten nakijken van het dictee met een antwoordblad direct na het dictee. Een effectieve strategie is de hierboven beschreven strategie waarbij kinderen het woord opdelen in klankgroepen en vervolgens per klankgroep de bijbehorende spellingregel(s) opnoemen en toepassen.

Met betrekking tot de variatie in spellingvaardigheid blijkt dat de meest effectieve instructie hetzelfde is voor zwakke als voor goede spellers, als ook voor spellers met een lage mate als met een hoge mate van spellingbewustzijn. Uiteraard hebben zwakke spellers wel meer instructie en oefening nodig om hetzelfde niveau te bereiken als goede spellers. De bevindingen in dit proefschrift tonen aan dat een relatief korte spellingtraining al voor een vooruitgang in spelling zorgt voor zowel goede als zwakke spellers. In mijn ogen toont dit aan dat er binnen het spellingonderwijs nog voldoende ruimte voor verbetering is. Hopelijk zal het onderzoek beschreven in dit proefschrift en de daaruit voortvloeiende conclusies en aanbevelingen leiden tot betere spellingprestaties bij de goede, maar vooral ook de zwakke spellers.

Dankwoord
Curriculum Vitae
Publications

Dankwoord

"The best things in life are the people we love, the places we've been, and the memories we've made along the way." – Author unknown

Op een zonnige lentemiddag schrijf ik met dubbele gevoelens dit laatste deel van mijn proefschrift. Ik vind het heel jammer dat ik dit promotietraject nu echt ga afronden, maar ik ben daarnaast ontzettend dankbaar dat ik zo heb mogen genieten van dit avontuur waaraan ik vijf jaar geleden ben begonnen. Dankbaar voor de mooie ervaringen die ik heb opgedaan, de mooie plekken waar ik ben geweest, maar vooral voor de lieve en inspirerende mensen die ik om mij heen heb gehad en gelukkig nog steeds heb. Ik ben in de afgelopen jaren veel uitdagingen tegengekomen en aangegaan. Hierdoor ben ik geworden wie ik nu ben en sta ik hier vandaag. Ik had nooit gedacht dat ik zo zou groeien, als onderzoeker, maar ook als persoon. Je kunt alleen maar groeien in een prettige omgeving met mensen om je heen die achter je staan. Die omgeving heb ik altijd gehad. Ik ben een aantal mensen daar zeer dankbaar voor.

Anna, ik had nooit zo kunnen genieten van dit avontuur als jij niet mijn begeleidster was geweest. Jij hebt mij de ruimte gegeven om mijn eigen weg te gaan; ik mocht de studies doen die ik graag wilde doen over de onderwerpen waarin ik geïnteresseerd was en nog steeds ben. Je hebt mij geïnspireerd en gestimuleerd om uitdagingen aan te gaan. Je gaf mij het gevoel dat je vertrouwen in me had en achter me stond. Als ik naar de VS wilde voor een cursus Non-Linear Methods, naar een SSSR-congres in Florida of Montreal, een summerschool in Egmond aan Zee, of een bezoek wilde brengen aan Chuck in Pittsburgh, jij was altijd enthousiast en gaf mij de steun die ik nodig had. Lieve Anna, bedankt dat ik van jou heb mogen leren en bedankt voor de kansen die je mij gegeven hebt op het gebied van onderzoek en onderwijs. Ik ben trots op het proefschrift dat er nu ligt en dat was nooit zo mooi geworden zonder jouw hulp.

Ludo, ook jou ben ik dankbaar voor je begeleiding en je kritische blik op mijn stukken. Je hebt mij vrij gelaten in het uitvoeren van mijn studies waardoor ik er echt mijn eigen project van heb kunnen maken. Je voelde precies aan wanneer ik je nodig had en op die momenten was je er voor me. Ik wil je bedanken voor je inhoudelijke bijdrage aan dit proefschrift, maar ook voor de fijne gesprekken en je gezelligheid tijdens de congressen, summerschool en schrijfweek. Als ik 'Hotel California' hoor, denk ik vaak terug aan onze schrijfweek in Durbuy; jij speelde gitaar en wij zongen mee.

Chuck, we drank our first beer together at the summer school in Egmond aan Zee, where you invited me to visit you in Pittsburgh. Thank you for those six weeks at the University of Pittsburgh, it was a great experience for me. I have learned so

much from the talks we went to and from the opportunity I got to discuss my research with you and present it to the members of your group. But I have learned even more from the conversations I had with you about research, America, and life. During those weeks, I grew so much as a researcher, but maybe even more as a person. I had a wonderful time and I learned that I am a stronger person than I had always thought I was. Thank you for making me feel so welcome, spending so much time with me, showing me the most beautiful places in Pittsburgh, inviting me to family dinners, drinking many beers together, and having so much fun! You are the best egg-hiding Easter Bunny I have ever met!

Daarnaast had ik dit proefschrift niet kunnen schrijven zonder de inzet van alle kinderen die deelnamen aan de verschillende studies. Allemaal bedankt (en natuurlijk ook jullie meesters, juffen en ouders)!

De afgelopen jaren ben ik elke ochtend met plezier naar mijn werk gefietst. Dat was niet alleen vanwege mijn leuke baan, maar ook vanwege mijn collega's. Lieve (oud)collega's, bedankt voor de gezellige lunches, OLO-uitjes, (promotie)feestjes en borrels, congressen, schrijfweken, summerschool, studiereis naar Boekarest (Lex, wat was het een mooie en vooral bijzondere ervaring om met jou samen deze groep studenten te begeleiden, bedankt dat je mij gevraagd hebt om met je mee te gaan) en bedankt voor het feit dat jullie deur altijd open staat! Marijke, bedankt dat ik tijdens mijn klinische stage zo veel van jou heb mogen leren en nog steeds van je mag leren. Dankzij jou heb ik kunnen werken met de kinderen waarvoor ik dit proefschrift geschreven heb; de kinderen voor wie het leren spellen een echte uitdaging is. Ik heb de inzet van deze kinderen, maar ook hun frustraties en verdriet mogen ervaren en heb daarom altijd geweten waar ik het voor deed. Bedankt daarvoor! Sophieke en Nathalie, wat was het leuk om samen met jullie de OLO-intervisiegroep op te zetten. Ik ben blij dat we onder het genot van een hapje en een drankje nog regelmatig bijkletsen. Marjolijn, bedankt dat jouw deur altijd open staat voor een gezellige babbel of een goed gesprek, jij bent de enige die mijn 'mannenadvies' zo serieus neemt dat je mij zelfs meeneemt naar een date! Anne-Els, Lanneke en Christel, bedankt voor jullie luisterend oor en voor de gezellige feestjes. Mieke, jij bent extra bijzonder voor mij en ik ben blij dat ik jou heb leren kennen.

Dan mijn paranimfen, wat ben ik blij en ontzettend trots dat jullie naast mij staan. Lieve Karien, of we nu samen een drankje doen, gezellig gaan eten, carnavallen, naar de Efteling gaan, samen proberen de BBQ aan te krijgen, met de mannen naar een 90's party gaan of 'gewoon' een avond kletsen, ik geniet altijd van de tijd die we samen doorbrengen. Met jou is het altijd fijn en nooit saai. Dank je wel dat je er altijd voor mij bent. Lieve Hanneke, bedankt voor al die gezellige stapavonden, etentjes, high teas, vakanties, sportavonturen, de fijne gesprekken en voor al die andere fijne momenten. Wat hebben wij samen toch een hoop plezier gehad de

afgelopen jaren en gelukkig hebben we dat nog steeds! Je bent er altijd voor mij en weet altijd precies wat je tegen me moet zeggen. Bedankt voor je steun en dat je zo'n fijne vriendin bent!

Lieve Ria en Adri, jullie zijn nog niet zo heel lang in mijn leven, maar in die korte tijd zijn jullie heel belangrijk voor mij geworden. Bedankt dat ik me bij jullie zo gewaardeerd en welkom voel.

Lieve Charelle, bedankt dat jij mijn kleine zusje bent. Ik kan mij nog herinneren dat ik je vasthield toen je net geboren was, maar nu ben je al een hele dame. Wat kan ik toch altijd lekker lachen met jou en wat voelt het fijn dat ik jouw grote zus mag zijn. Ik geniet altijd zo van de shop-dagjes, gezellige avondjes, etentjes, dagjes weg en vakanties met ons allen. Bedankt daarvoor, ik ben trots dat jij mijn zusje bent. Stefan, ik ben blij dat jij mijn 'schoonbroer' bent. Het is gezellig als we samen zijn en met jou erbij kunnen we altijd lachen. Sjimmie, bedankt!

Lieve papa en mama, wat ben ik ontzettend gelukkig, dankbaar en trots dat jullie mijn ouders zijn. Jullie hebben mij altijd gestimuleerd om mijn dromen te volgen en de bijbehorende uitdagingen aan te gaan. Jullie zijn er altijd voor me en staan altijd achter me. Lieve papa, als kleine hummel nam je mij al mee naar je lab om daar je proefschrift af te schrijven. Nu ligt hier mijn eigen proefschrift. De passie voor en het plezier in het doen van onderzoek heb ik zeker van jou. Lekker genieten van het leven, met een biertje in de zon, op vakanties, tijdens gezellige avonden of etentjes, tijdens feestjes met vrienden of gewoon lekker op de fiets, ik leer zoveel van jou. Pap, je bent mijn grote voorbeeld. Lieve mama, zonder jou had dit proefschrift hier niet gelegen. Geloven in mezelf, dat kan ik helaas nog niet zo goed, maar gelukkig doe jij dat wel en heb je dat ook altijd gedaan. Er is nooit een belangrijk moment geweest waarop jij mij niet even belde of sms'te om me succes te wensen en me te laten weten dat ik het echt wel kon. Jouw vertrouwen in mij betekent veel voor me. Dank je wel dat je er altijd voor zorgt dat het fijn is om thuis te komen, ik geniet van de tijd die we samen doorbrengen.

Roy, lieve schat, deze laatste woorden van mijn proefschrift zijn voor jou. Wat ben ik ontzettend blij en dankbaar dat ik samen met jou van het leven mag genieten. Met jou samen is elke dag een cadeautje en door jou besef ik hoe rijk mijn leven is. Jij maakt mij zo onwijs gelukkig en ik kijk dan ook uit naar alle avonturen die we samen nog mogen gaan beleven!

Curriculum Vitae

Kim Cordewener was born on the 15th of April 1985 in Wageningen, the Netherlands. She attended secondary education (pre-university education) at Pantarijn in Wageningen and received her diploma in 2003. She went on to study at the Radboud University in Nijmegen where she obtained her Bachelor's degree in Pedagogical Science in 2006. Subsequently, she applied for and was admitted to the Research Master Behavioural Science at the Behavioural Science Institute (BSI) of the Radboud University. She performed her research internship at the Department of Learning and Plasticity, where she studied the predictors of early literacy skills of children with specific language impairment under the supervision of Prof. Anna M. T. Bosman and Prof. Ludo Verhoeven. She also did the clinical track supervised by Drs. Marijke G. J. van Beurden, and completed her internship for Pedagogical Science at a primary school in Nijmegen. In 2009, she graduated *cum laude* for her Master's Degree, after she had started her PhD project at the BSI of the Radboud University, being supervised by Prof. Anna M. T. Bosman and Prof. Ludo Verhoeven. The main goal of her project was to investigate variation in spelling ability in children, with special focus on the precursors and acquisition of spelling, and on spelling instruction. During her PhD project, she presented the results of her research at both national and international conferences. She participated in an International Summer School (Egmond aan Zee, 2012) and was invited by Prof. Charles A. Perfetti of the University of Pittsburgh in the United States to join his research group for six weeks at the Learning Research and Development Center (LRDC). The results of her studies are described in this thesis, and most of the research has been published in both national and international scientific journals. Next to her research activities, she taught several courses in both the Bachelor and the Master Program of Pedagogical Science, for which she received the University Teaching Qualification (BKO).

After finishing her PhD project, Kim became a full time teacher at the Radboud University, where she is involved in several courses, both clinical as well as research oriented, in both the Bachelor and the Master Program of Pedagogical Science.

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Behavioural Science Institute

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